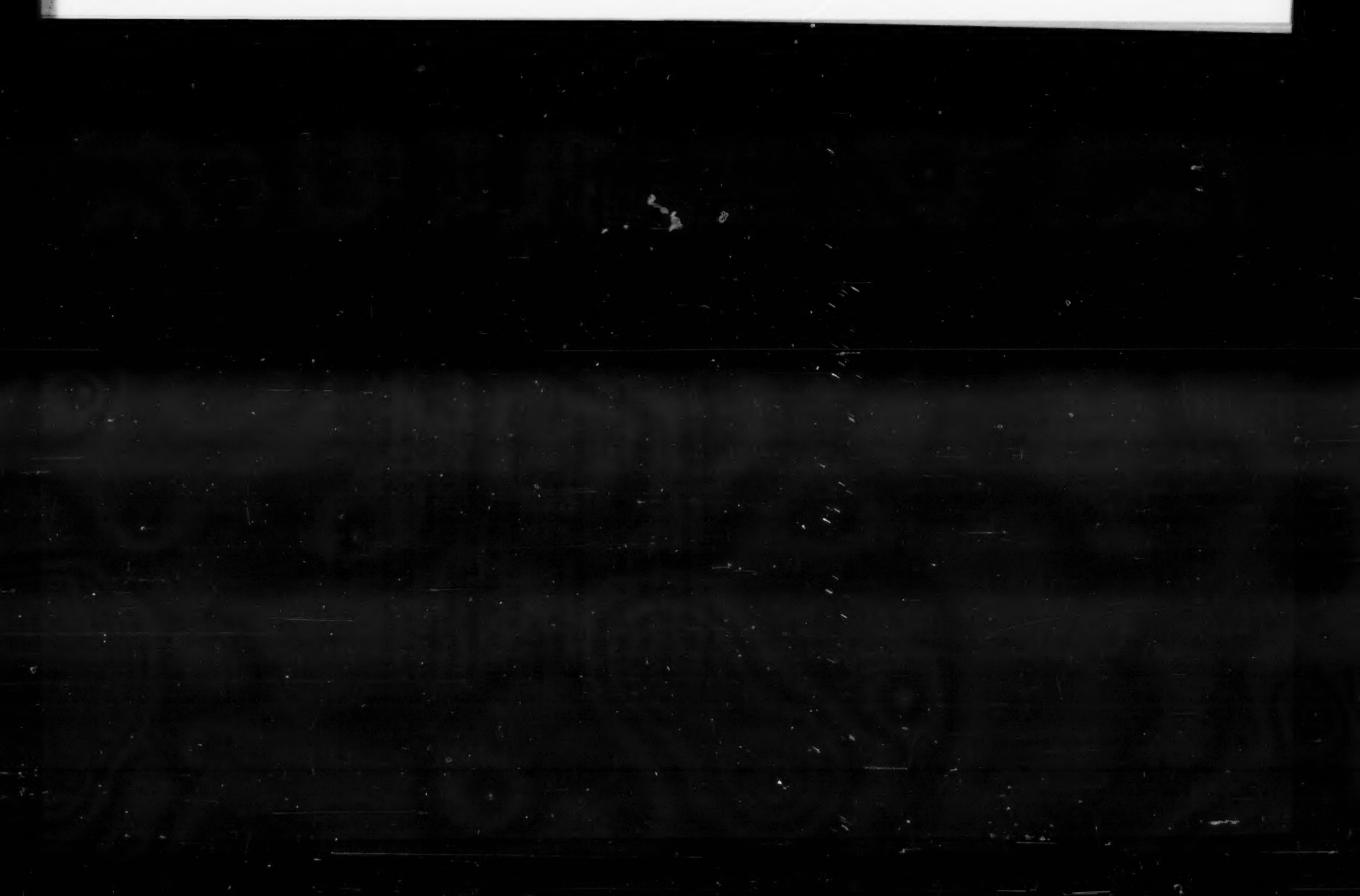

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AND

MINUTES OF PROCEEDINGS

OF

THE ROYAL SOCIETY OF CANADA

1953

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1953

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1942—KLINCK, LEONARD S., M.S.A., D.Sc., LL.D., 2627 Marine Drive, West Vancouver, B.C.
1941—MACKENZIE, C. J., C.M.G., M.C., B.E., M.C.E., D.Sc., LL.D., F.R.S., President, Atomic Energy of Canada, Limited, Ottawa, Ont.
1937—MORGAN, A. E., M.A., LL.D., The Athenaeum, Pall Mall, London, S.W.1, England.
1952—VANDRY, Mgr F., C.M.G., P.A., Ph.D., Recteur de l'Université Laval, Québec, Qué.

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1941—McIlwraith, T. F., M.A., University of Toronto, Toronto, Ont.
1942—Michell, Humfrey, M.A., Lennoxville, Que.
1946—Muckle, Rev. J. T., M.A., C.S.B., The Pontifical Institute of Mediaeval Studies, 59 Queen's Park Crescent, Toronto, Ont.
1937—New, Chester W., B.D., Ph.D., 112 Stirling St., Hamilton, Ont.
1943—Norwood, Gilbert, M.A., D.Litt., University of Toronto, Toronto, Ont.

1950—Pegis, A. C., M.A., Ph.D., The Pontifical Institute of Mediaeval Studies, 59 Queen's Park Crescent, Toronto, Ont.
1942—Phelan, Gerald B., S.T.B., M.A., Ph.D., LL.D., St. Michael's College, Toronto, Ont.
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1930—Pratt, E. J., C.M.G., M.A., Ph.D., Victoria College, Toronto, Ont.
1953—Priestley, F. E. L., M.A., Ph.D., University of Toronto, Toronto, Ont.
1953—Raddall, T. H., LL.D., 44 Park St., Liverpool, N.S.
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1953—Rose, W. J., M.A., Ph.D., United College, Winnipeg, Man.
1937—Sage, Walter N., M.A., Ph.D., University of British Columbia, Vancouver, B.C.
1942—Salter, Frederick M., A.M., University of Alberta, Edmonton, Alta.
1947—Scott, Francis R., B.Litt., B.C.L., McGill University, Montreal, Que.
1946—Shaw, J. E., Ph.D., 75 Walmer Road, Toronto, Ont.
1948—Sissons, C. B., LL.D., Newcastle, Ont.
1950—Smith, S. E., Q.C., M.A., LL.B., LL.D., D.C.L., President, University of Toronto, Toronto, Ont.
1947—Soward, F. H., B.Litt., University of British Columbia, Vancouver, B.C.
1951—Stacey, Charles P., O.B.E., A.M., Ph.D., Department of National Defence, Ottawa, Ont.
1933—Stanley, Carleton, M.A., LL.D., Litt.D., 813 Grosvenor Ave., Winnipeg, Man.
1953—Stanley, G. F. G., M.A., Ph.D., Royal Military College of Canada, Kingston, Ont.
1942—Stevenson, G. H., M.D., The Ontario Hospital, London, Ont.
1930—Surveyer, Hon. E. Fabre, Q.C., B.C.L., LL.D., LL.M., The Judges' Chambers, Montreal, Que.
1949—Talman, James J., M.A., Ph.D., University of Western Ontario, London, Ont.
1951—Taylor, Kenneth W., C.B.E., M.A., LL.D., Department of Finance, Ottawa, Ont.
1941—Thompson, H. A., M.A., Ph.D., The Institute for Advanced Study, Princeton, N.J., U.S.A.
1942—Thomson, James S., M.A., D.D., McGill University, Montreal, Que.
1951—Timlin, Mabel F., B.A., Ph.D., University of Saskatchewan, Saskatoon, Sask.
1942—Todd, Otis J., Ph.D., University of British Columbia, Vancouver, B.C.
1949—Underhill, Frank H., M.A., University of Toronto, Toronto, Ont.
1950—Wilson, G. E., M.A., Ph.D., Dalhousie University, Halifax, N.S.
1942—Woodhouse, A. S. P., M.A., D. Litt., University College, Toronto, Ont.

Section III.—Chemical, Mathematical, and Physical Sciences

Retired Members

1934—Alty, Thomas, D.Sc., Ph.D., Glasgow University, Glasgow, Scotland.
1929—Ardagh, E. G. R., B.A.Sc., F.C.I.C., 80 Strathallan Boulevard, Toronto 12, Ont.
1915—Bain, James Watson, M.B.E., B.A.Sc., 30 Burton Road, Toronto, Ont.
1921—Boswell, M. C., B.A.Sc., M.A., Ph.D., University of Toronto, Toronto, Ont.

1916—Bronson, H. L., Ph.D., Dalhousie University, Halifax, N.S.
1915—Clark, A. L., B.Sc., Ph.D., Queen's University, Kingston, Ont.
1928—Dines, Lloyd L., M.A., Ph.D., Carnegie Institute of Technology, Pittsburgh, Pa., U.S.A.
1924—Ferguson, John Bright, B.A., 106 Stuart Ave., Willowdale, Ont.
1922—Hughes, A. Ll., B.A., B.Sc., Washington University, St. Louis, Mo., U.S.A.
1915—King, Louis Vessot, M.A., D.Sc., F.R.S., McGill University, Montreal, Que.
1930—Lang, R. J., M.A., Ph.D., University of Alberta, Edmonton, Alta.
1940—McClung, Robert K., M.A., D.Sc., University of Manitoba, Winnipeg, Man.
1902—Owens, R. B., D.S.O., D.Sc., Maryland Academy of Sciences, Baltimore, Md., U.S.A.
1919—Parker, Matthew A., B.Sc., LL.D., F.R.I.C., University of Manitoba, Winnipeg, Man.
1926—Robertson, J. K., M.A., Queen's University, Kingston, Ont. (Ex-President.)
1917—Satterly, John, M.A., D.Sc., A.R.C.Sc., University of Toronto, Toronto, Ont.
1934—Stevenson, Arthur F. C., M.A., Ph.D., 28 Summerhill Gardens, Toronto, Ont.
1932—Synge, John L., M.A., Sc.D., F.R.S., Ohio State University, Columbus, Ohio, U.S.A.
1924—Whitby, George Stafford, D.Sc., Ph.D., LL.D., A.R.C.Sc., University of Akron, Akron, Ohio, U.S.A.
1910—Wilson, Harold A., F.R.S., Houston, Texas, U.S.A.
1923—Young, R. K., Ph.D., University of Toronto, Toronto, Ont.

Active Members

1953—Adams, G. A., M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1909—Allen, Frank, M.A., Ph.D., LL.D., 6A Linda Lee Apts., Hargrave St., Winnipeg, Man.
1947—Archibald, William J., M.A., Ph.D., Dalhousie University, Halifax, N.S.
1948—Babbitt, J. D., D.Phil., Canadian Scientific Liaison Officer, Washington, D.C., U.S.A.
1938—Barnes, William H., M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1933—Basterfield, Steward, B.Sc., Ph.D., McMaster University, Hamilton, Ont.
1933—Beals, C. S., M.A., D.I.C., Ph.D., D.Sc., F.R.S., Dominion Observatory, Ottawa, Ont.
1925—Beatty, Samuel, M.A., Ph.D., University of Toronto, Toronto, Ont.
1953—Bernstein, H. J., M.A., Ph.D., National Research Council, Ottawa, Ont.
1921—Boyle, R. W., M.A., M.Sc., Ph.D., LL.D., Rideau Club, Ottawa, Ont.
1945—Brauer, Richard, Ph.D., Harvard University, Cambridge, Mass., U.S.A.
1939—Brocklesby, Horace N., M.Sc., Ph.D., F.R.I.C., F.C.I.C., 501 Seaside Ave., Terminal Island, Calif., U.S.A.
1940—Campbell, Alan N., Ph.D., D.Sc., F.R.I.C., University of Manitoba, Winnipeg, Man.
1936—Campbell, J. W., M.A., Ph.D., University of Alberta, Edmonton, Alta.
1941—Campbell, W. Boyd, B.Sc., Ph.D., Pulp and Paper Research Institute of Canada, Montreal, Que.
1951—Carmichael, Hugh, B.Sc., Ph.D., Atomic Energy of Canada, Limited, Chalk River, Ont.
1923—Chant, C. A., M.A., Ph.D., LL.D., Observatory House, Richmond Hill, Ont.

1928—Clark, Robert H., M.A., Ph.D., University of British Columbia, Vancouver, B.C.
1935—Coffin, C. C., Ph.D., Dalhousie University, Halifax, N.S.
1941—Coxeter, H. S. M., Ph.D., F.R.S., University of Toronto, Toronto, Ont.
1939—Crawford, M. F., M.A., Ph.D., University of Toronto, Toronto, Ont.
1947—Currie, B. W., M.Sc., Ph.D., University of Saskatchewan, Saskatoon, Sask.
1950—Darwent, B. de B., B.Sc., Ph.D., c/o Olin Industries Ltd., New Haven, Conn., U.S.A.
1948—Davies, Frank T., B.Sc., M.Sc., Telecommunications Establishment, Defence Research Board, Ottawa, Ont.
1944—Dearle, Raymond C., M.B.E., M.A., Ph.D., University of Western Ontario, London, Ont.
1938—De Lury, Ralph E., M.A., Ph.D., 330 Fairmount Ave., Ottawa, Ont.
1951—Demers, Pierre, L.Sc., M.Sc., D.Sc., University of Montreal, Montreal, Que.
1949—Elliott, L. G., M.Sc., Ph.D., Atomic Energy of Canada, Limited, Chalk River, Ont.
1944—Field, George S., M.B.E., M.Sc., D.Sc., Defence Research Board, Ottawa, Ont.
1950—Flood, E. A., O.B.E., B.Sc., Sc.M., A.M., Ph.D., National Research Council, Ottawa, Ont.
1929—Foster, John Stuart, D.Sc., Ph.D., F.R.S., McGill University, Montreal, Que.
1940—Gagnon, Paul E., D.I.C., Ph.D., D.Sc., 127 Grande Allée, Quebec, Que.
1925—Gilchrist, Lachlan, Ph.D., University of Toronto, Toronto, Ont.
1952—Gishler, P. E., M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1937—Gordon, Andrew R., O.B.E., M.A., Ph.D., University of Toronto, Toronto, Ont.
1922—Gray, J. A., D.Sc., F.R.S., Queen's University, Kingston, Ont.
1950—Hachey, H. B., M.B.E., E.D., B.Sc., M.Sc., LL.D., Fisheries Research Board of Canada, St. Andrews, N.B.
1953—Halperin, I., M.A., Ph.D., Queen's University, Kingston, Ont.
1932—Harrington, E. L., M.Sc., Ph.D., 5040 Sierra, Riverside, Calif., U.S.A.
1932—Hatcher, William H., M.Sc., Ph.D., McGill University, Montreal, Que.
1944—Henderson, John T., M.B.E., M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1949—Henderson, W. J., M.A., Ph.D., Atomic Energy of Canada, Limited, Chalk River, Ont.
1939—Herzberg, Gerhard, M.A., Dipl. Ing., Dr.Ing., LL.D., F.R.S., National Research Council, Ottawa, Ont.
1945—Hewson, E. Wendell, M.A., D.I.C., Ph.D., 1405 Arbor View Blvd., Ann Arbor, Mich., U.S.A.
1936—Hodgson, Ernest A., M.A., Ph.D., Box 235, Port Perry, Ont.
1946—Hogg, Helen S., A.M., Ph.D., David Dunlap Observatory, University of Toronto, Toronto, Ont.
1949—Holmes, R. H. L., M.Sc., A.M., Ph.D., Carwin Company, North Haven, Conn., U.S.A.
1946—Howlett, L. E., M.B.E., M.A., Ph.D., National Research Council, Ottawa, Ont.
1947—Infeld, Leopold, Ph.D., University of Warsaw, Warsaw, Poland.
1943—James, R. D., M.A., Ph.D., University of British Columbia, Vancouver, B.C.
1937—Jeffery, Ralph L., M.A., Ph.D., Queen's University, Kingston, Ont.

1951—Johns, Harold E., M.A., Ph.D., University of Saskatchewan, Saskatoon, Sask.
1948—Jones, R. Norman, M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1952—Katz, Leon, M.Sc., Ph.D., University of Saskatchewan, Saskatoon, Sask.
1926—Keys, David A., M.A., D.Sc., Ph.D., Atomic Energy of Canada, Limited, Chalk River, Ont.
1953—Kulka, M., M.Sc., Ph.D., F.C.I.C., Dominion Rubber Company, Ltd., Guelph, Ont.
1943—Langstroth, G. O., Ph.D., Experimental Station, Suffield, Alta.
1941—Laurence, G. C., M.B.E., M.Sc., Ph.D., Atomic Energy of Canada, Limited, Chalk River, Ont.
1947—LeRoy, Donald J., M.A., Ph.D., University of Toronto, Toronto, Ont.
1952—Lewis, W. B., C.B.E., M.A., Ph.D., F.R.S., Atomic Energy of Canada, Limited, Chalk River, Ont.
1922—Maass, Otto, C.B.E., D.Sc., Ph.D., LL.D., F.R.S., McGill University, Montreal, Que.
1953—Macphail, M. S., M.A., Ph.D., Carleton College, Ottawa, Ont.
1935—Manske, Richard H., M.Sc., D.Sc., Ph.D., Research Laboratory, Dominion Rubber Co., Guelph, Ont.
1942—Marion, Léo E., M.B.E., M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1953—Marshall, J. S., M.A., Ph.D., McGill University, Montreal, Que.
1951—Mason, Stanley G., B.Eng., Ph.D., Pulp and Paper Research Institute of Canada, Montreal, Que.
1948—McIntosh, Robert L., M.Sc., Ph.D., University of Toronto, Toronto, Ont.
1942—McKellar, Andrew, M.B.E., M.A., Ph.D., Dominion Astrophysical Observatory, Victoria, B.C.
1952—McKinley, D. W. R., O.B.E., M.A., Ph.D., National Research Council, Ottawa, Ont.
1936—McLay, A. B., M.A., Ph.D., McMaster University, Hamilton, Ont.
1938—McRae, John Alexander, M.A., Ph.D., Queen's University, Kingston, Ont.
1943—Middleton, W. E. K., M.Sc., National Research Council, Ottawa, Ont.
1942—Miller, Andrew H., M.A., 326 Fairmont Ave., Ottawa, Ont.
1949—Misener, A.D., M.A., Ph.D., University of Western Ontario, London, Ont.
1947—Munro, L. A., M.A., Ph.D., Queen's University, Kingston, Ont.
1942—Niven, Charles D., B.Sc., Ph.D., National Research Council, Ottawa, Ont.
1950—Ouellet, Cyrias, B.A.Sc., D.Sc., Laval University, Quebec, Que.
1940—Pall, Gordon, M.A., Ph.D., Illinois Institute of Technology, Chicago, Ill., U.S.A.
1933—Parkin, J. H., C.B.E., B.A.Sc., M.E., National Research Council, Ottawa, Ont.
1918—Patterson, John, O.B.E., M.A., LL.D., Meteorological Service of Canada, Toronto, Ont.
1931—Pearce, J. A., M.A., Ph.D., Dominion Astrophysical Observatory, Victoria, B.C. (Ex-President.)
1940—Petrie, R.M., M.B.E., A. M., Ph.D., Dominion Astrophysical Observatory, Victoria, B.C.
1950—Petrie, William, A. M., Ph.D., Defence Research Board, Ottawa, Ont.
1942—Pidgeon, Lloyd M., M.B.E., M.Sc., Ph.D., University of Toronto, Toronto, Ont.
1949—Puddington, I. E., M.Sc., Ph.D., National Research Council, Ottawa, Ont.

1949—PURVES, C. B., B.Sc., Ph.D., D.Sc., McGill University, Montreal, P.Q.
1944—ROBINSON, GILBERT DE B., O.B.E., Ph.D., University of Toronto, Toronto, Ont.
1936—ROSE, DONALD C., O.B.E., M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1947—SANDIN, R. B., M.Sc., Ph.D., University of Alberta, Edmonton, Alta.
1941—SARGENT, B. W., M.B.E., M.A., Ph.D., Queen's University, Kingston, Ont.
1952—SCHERK, PETER, Ph.D., University of Saskatchewan, Saskatoon, Sask.
1951—SCHNEIDER, WILLIAM G., M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1923—SHAW, A. NORMAN, M.A., D.Sc., McGill University, Montreal, Que.
1935—SHRUM, G. M., O.B.E., M.A., Ph.D., University of British Columbia, Vancouver, B.C.
1940—SMITH, H. GRAYSON, M.A., Ph.D., University of Alberta, Edmonton, Alta.
1943—SPINKS, J. W. T., B.Sc., Ph.D., University of Saskatchewan, Saskatoon, Sask.
1934—STEACIE, E. W. R., O.B.E., Ph.D., D.Sc., F.R.S., President, National Research Council, Ottawa, Ont.
1926—STEWART, R. MELDRUM, M.A., 5 Woodlawn Ave., Ottawa, Ont.
1943—THODE, H. G., M.Sc., Ph.D., McMaster University, Hamilton, Ont.
1935—THOMSON, ANDREW, O.B.E., M.A., Meteorological Service of Canada, Toronto, Ont.
1926—THORVALDSON, T., A.M., Ph.D., D.Sc., LL.D., University of Saskatchewan, Saskatoon, Sask.
1948—VOLKOFF, GEORGE M., M.B.E., M.A., Ph.D., D.Sc., University of British Columbia, Vancouver, B.C.
1945—WALKER, OSMAN J., A.M., Ph.D., University of Alberta, Edmonton, Alta.
1937—WATSON, WILLIAM H., M.A., Ph.D., University of Toronto, Toronto, Ont.
1952—WELSH, H. L., M.A., Ph.D., University of Toronto, Toronto, Ont.
1935—WILLIAMS, W. L. G., M.A., Ph.D., McGill University, Montreal, Que.
1946—WINKLER, C. A., O.B.E., M.Sc., Ph.D., McGill University, Montreal, Que.
1950—WOONTON, G. A., M.A., McGill University, Montreal, Que.
1951—WYMAN, MAX, B.Sc., Ph.D., University of Alberta, Edmonton, Alta.

SECTION IV.—GEOLOGICAL SCIENCES

Retired Members

1928—BOYD, W. H., B.A.Sc., 69 Dunvegan Road, Toronto, Ont.
1928—DE LURY, JUSTIN S., Ph.D., P.O. Box 22, Uxbridge, Ont.
1926—DENIS, T. C., D.Sc., 130 Maple Avenue, Quebec, Que.
1926—MALCOLM, WYATT, M.A., 376 Hinton Ave., Ottawa, Ont.

Active Members

1925—ALCOCK, F. J., Ph.D., National Museum of Canada, Ottawa, Ont.
1922—ALLAN, JOHN A., M.Sc., Ph.D., 11138, 90th Ave., Edmonton, Alta.
1944—AMBROSE, JOHN W., Ph.D., Queen's University, Kingston, Ont.
1950—ARMSTRONG, J. E., M.A.Sc., Ph.D., Dept. of Mines and Technical Survey, Vancouver, B.C.
1950—AUGER, P. E., B.Sc., D.Sc., Laval University, Quebec, Que.
1931—BAKER, M. B., B.Sc., LL.D., Queen's University, Kingston, Ont.
1920—BANCROFT, J. AUSTEN, A.M., Ph.D., P.O. Box 4587, Johannesburg, South Africa.

1925—Bell, W. A., B.Sc., Ph.D., Geological Survey, Ottawa, Ont.
1951—Berry, Leonard G., M.A., Ph.D., Queen's University, Kingston, Ont.
1940—Bostock, Hugh S., M.Sc., Ph.D., Geological Survey, Ottawa, Ont.
1951—Brownell, George M., M.Sc., Ph.D., University of Manitoba, Winnipeg, Man.
1930—Cairnes, C. E., B.S., M.A., Ph.D., Geological Survey, Ottawa, Ont.
1948—Caley, John F., M.Sc., M.A., Ph.D., Geological Survey, Ottawa, Ont.
1953—Campbell, Neil, B.Sc., Ph.D., Consolidated Mining and Smelting Company of Canada, Trail, B.C.
1918—Camsell, Charles, C.M.G., LL.D., 412 Victoria Bldg., Ottawa, Ont. (Ex-President.)
1933—Clark, Thomas H., M.A., Ph.D., McGill University, Montreal, Que.
1931—Cockfield, W. E., M.Sc., Ph.D., Geological Survey, 300 W. Pender St., Vancouver, B.C.
1923—Cooke, H. C., M.A., Ph.D., 35, Côte St. Antoine, Westmount, Que.
1943—Denis, Bertrand T., B.Sc., Ph.D., Bureau of Mines, Quebec, Que.
1946—Derry, D. R., M.A., Ph.D., 25 King St. West, Toronto, Ont.
1926—Dolmage, Victor, Ph.D., 1318 Marine Bldg., Vancouver, B.C.
1944—Douglas, G. Vibert, M.C., M.Sc., Dalhousie University, Halifax, N.S.
1915—Dresser, John A., M.A., LL.D., 61 Chesterfield Ave., Westmount, Que. (Life member.)
1950—Edmunds, F. H., M.Sc., University of Saskatchewan, Saskatoon, Sask.
1952—Faessler, Carl, Ph.D., Laval University, Quebec, Que.
1953—Fortier, Y. O., B.Sc., M.Sc., Ph.D., Geological Survey of Canada, Ottawa, Ont.
1950—Fraser, H. J., M.Sc., Ph.D., 44 King St. West, Toronto, Ont.
1942—Fritz, Madeleine A., M.A., Ph.D., Royal Ontario Museum, Toronto, Ont.
1947—Furnival, G. M., M.A., Ph.D., California Standard Co., Calgary, Alta.
1938—Gill, James Edward, B.Sc., Ph.D., McGill University, Montreal, Que.
1920—Graham, Richard P. D., D.Sc., McGill University, Montreal, Que.
1935—Gunning, H. C., B.A.Sc., S.M., Ph.D., University of British Columbia, Vancouver, B.C.
1930—Hanson, George, M.A., Ph.D., Geological Survey, Ottawa, Ont.
1952—Harrison, J. M., B.Sc., M.A., Ph.D., Geological Survey, Ottawa, Ont.
1934—Hawley, J. E., M.A., Ph.D., Queen's University, Kingston, Ont.
1947—Henderson, J. F., B.Sc., Ph.D., Geological Survey, Ottawa, Ont.
1929—Hume, George Sherwood, O.B.E., Ph.D., Geological Survey, Ottawa, Ont.
1940—Hurst, M. E., M.A., Ph.D., Department of Mines, Toronto, Ont.
1919—Johnston, R. A. A., B.A., 112 Old Forest Hill Road, Toronto, Ont.
1943—Jolliffe, A. W., M.A., Ph.D., Queen's University, Kingston, Ont. (Life member.)
1941—Jones, I. W., B.Sc., Ph.D., Bureau of Mines, Quebec, Que.
1948—Kindle, Edward D., M.A., Ph.D., Geological Survey, Ottawa, Ont.
1920—Knight, C. W., B.Sc., R.R. 3, 1545 Forest Road, Port Credit, Ont.
1951—Lang, Arthur H., M.A., Ph.D., Geological Survey of Canada, Ottawa, Ont.
1910—Langford, George B., B.A.Sc., Ph.D., University of Toronto, Toronto, Ont.
1949—Laverdière, L'abbé J. W., L. Sc., D.Sc., Laval University, Quebec, Que.
1949—Lord, C. S., B.A.Sc., M.A.Sc., Ph.D., Geological Survey, Ottawa, Ont.
1928—MacKay, B. R., B.Sc., Ph.D., Geological Survey, Ottawa, Ont.

1952—MacKenzie, G. S., B.Sc., M.A., Ph.D., University of New Brunswick, Fredericton, N.B.
1933—Mawdsley, James Buckland, B.Sc., Ph.D., University of Saskatchewan, Saskatoon, Sask.
1947—McGerrigle, H. W., Ph.D., Bureau of Mines, Quebec, Que.
1927—McLearn, F. H., B.E., Ph.D., Geological Survey, Ottawa, Ont.
1924—Moore, Elwood S., M.A., Ph.D., University of Toronto, Toronto, Ont. (Ex-President.)
1937—Norman, G. W. H., B.A.Sc., Ph.D., Ming Mountain Mining Corporation, Jerome, Ariz., U.S.A.
1945—Okulitch, Vladimir J., M.A.Sc., Ph.D., University of British Columbia, Vancouver, B.C.
1925—O'Neill, J. J., M.Sc., Ph.D., 3246 The Boulevard, Westmount, Que. (Ex-President.)
1937—Osborne, Freleigh F., M.A.Sc., Ph.D., Laval University, Quebec, Que.
1941—Parsons, A. L., B.A., 360 Fairlawn Ave., Toronto, Ont.
1927—Poitevin, Eugène, B.A.Sc., D.Sc., Geological Survey, Ottawa, Ont.
1946—Rice, H. M. A., M.A.Sc., Ph.D., Geological Survey, Ottawa, Ont.
1936—Rickaby, H. C., M.A., Deputy Minister of Mines, Toronto, Ont.
1927—Rose, Bruce, B.Sc., Ph.D., Queen's University, Kingston, Ont.
1936—Russell, L. S., B.Sc., M.A., Ph.D., National Museum of Canada, Ottawa, Ont.
1938—Slipper, Stanley Eades, B.Sc., 307, 6th Ave., West, Calgary, Alta.
1949—Sternberg, C. M., National Museum of Canada, Ottawa, Ont.
1949—Stevenson, J. S., B.A.Sc., Ph.D., McGill University, Montreal, Que.
1936—Stockwell, C. H., B.A.Sc., Ph.D., Victoria Museum, Ottawa, Ont.
1939—Swanson, C. O., M.A.Sc., Ph.D., Consolidated Mining and Smelting Co., Ltd., Trail, B.C.
1927—Tanton, Thomas L., M.A., Ph.D., Geological Survey, Ottawa, Ont.
1942—Taylor, Griffith, B.Sc., B.E., D.Sc., 28 Alan Ave., Seaforth, N.S.W., Australia.
1945—Thomson, J. E., M.A., Ph.D., Department of Mines, Toronto, Ont.
1910—Tyrrell, Joseph B., M.A., B.Sc., LL.D., Room 1821, 44 King St. West, Toronto, Ont. (Life member.)
1937—Walker, John F., B.A.Sc., Ph.D., Deputy Minister of Mines, Victoria, B.C.
1921—Wallace, R. C., C.M.G., M.A., Ph.D., D.Sc., LL.D., D.C.L., 4 Centre St., Kingston, Ont. (Ex-President.)
1945—Warren, Harry V., B.A.Sc., D.Phil., University of British Columbia, Vancouver, B.C.
1931—Warren, P. S., Ph.D., A.R.C.S., University of Alberta, Edmonton, Alta.
1953—Watson, J. W., M.A., Ph.D., Geographical Branch, Department of Mines and Technical Surveys, Ottawa, Ont.
1953—Weeks, L. J., B.Sc., M.A., Ph.D., Geological Survey of Canada, Ottawa, Ont.
1939—Wickenden, R. T. D., Ph.B., M.A., Ph.D., 406 Customs Bldg., Calgary, Alta.
1926—Williams, M. Y., B.Sc., Ph.D., University of British Columbia, Vancouver, B.C.
1938—Wilson, Alice Evelyn, M.B.E., Ph.D., Geological Survey, Ottawa, Ont.
1948—Wilson, J. Tuzo, O.B.E., M.A., Ph.D., University of Toronto, Toronto, Ont.
1924—Wilson, Morley Evans, Ph.D., Geological Survey, Ottawa, Ont.
1932—Wright, J. F., Ph.D., 121 Southern Drive, Ottawa, Ont.
1932—Wright, W. J., B.Sc., M.A., Ph.D., 117 Church St., Fredericton, N.B.

Section V.—BIOLOGICAL SCIENCES

Retired Members

1919—Cameron, John, M.D., D.Sc.
1946—Craigie, James, O.B.E., M.B., Ph.D., D.P.H., F.R.S., Imperial Cancer Research Fund, Burtonhole Lane, The Ridgeway, Mill Hill, N.W. 7, London, England.
1936—Dearness, John, M.A., LL.D., 30 Marley Place, London, Ont.
1941—DeGryse, J. J., Ph.D., Department of Agriculture, Ottawa, Ont.
1912—Faull, J. H., Ph.D., Jamaica Plains, Mass., U.S.A.
1919—Geddes, Sir Auckland, Frencham, The Layne, Rolvenden, by Cranbrook, Kent, England.
1922—Gibson, Arthur, LL.D., F.E.S., F.E.S.A., 30 Cooper St., Ottawa, Ont.
1916—Hunter, Andrew, C.B.E., M.A., B.Sc., M.B., Ch.B., F.R.S.E., University of Toronto, Toronto, Ont.
1911—Leathes, John B., B.Ch., Sheffield, England.
1918—Lewis, Francis J., D.Sc., F.R.S.E., F.L.S., University of Alberta, Edmonton, Alta.
1909—MacBride, Ernest W., M.A., F.R.S., London, England.
1937—Marrian, Guy F., D.Sc., F.R.I.C., Department of Medical Chemistry, University of Edinburgh, Edinburgh, Scotland.
1937—McDunnough, J. H., M.A., Ph.D., Department of Agriculture, Ottawa, Ont.
1922—Miller, James, M.D., D.Sc., F.R.C.P.E., F.R.C.P.(C), Westend House, Witney, Oxfordshire, England.
1922—Miller, F. R., M.A., M.B., M.D., F.R.C.P.(C), F.R.S., University of Western Ontario, London, Ont.
1913—Moore, Clarence, M.A., Pictou, N.S.
1930—Newton, Robert, M.C., B.S.A., M.Sc., Ph.D., Box 147, White Rock Hilltop, B.C.
1922—O'Donoghue, Chas. H., D.Sc., F.Z.S., University of Reading, Reading, England.
1928—Swaine, James M., C.B.E., B.S.A., M.Sc., Ph.D., 484 Brierwood Ave., Ottawa, Ont.
1915—Walker, Edmund Murton, B.A., M.B., University of Toronto, Toronto, Ont.
1932—Whitnall, S. E., M.A., M.D., B.Ch., M.R.C.S.

Active Members

1944—Anderson, J. A., M.Sc., Ph.D., Grain Research Laboratory, Winnipeg, Man.
1939—Anderson, R. M., B.Ph., Ph.D., 58, The Driveway, Ottawa, Ont.
1937—Bailey, Dixon L., M.S., Ph.D., University of Toronto, Toronto, Ont.
1952—Bannan, M. W., Ph.D., University of Toronto, Toronto, Ont.
1936—Berrill, N. J., Ph.D., D.Sc., F.R.S., McGill University, Montreal, Que.
1931—Best, Charles H., C.B.E., M.A., M.D., D.Sc., F.R.C.P.(C), F.R.S., Hon. D.Sc. (Oxon.), University of Toronto, Toronto, Ont.
1924—Boyd, William, M.D., F.R.C.P., LL.D., University of British Columbia, Vancouver, B.C.
1936—Brittain, W. H., B.S.A., M.S., Ph.D., Macdonald College, Que.
1939—Browne, J. S. L., B.Sc., M.D., Ph.D., Royal Victoria Hospital, Montreal, Que.

1952—Burton, A. C., M.B.E., B.Sc., M.A., Ph.D., University of Western Ontario, London, Ont.
1939—Cameron, Thomas W. M., M.A., D.Sc., Ph.D., M.R.C.V.S., Macdonald College, Que.
1933—Campbell, Walter R., M.A., M.D., F.R.C.P.(C), Medical Arts Bldg., Toronto, Ont.
1925—Clemens, W. A., M.A., Ph.D., University of British Columbia, Vancouver, B.C.
1925—Collip, J. B., C.B.E., Ph.D., M.D., D.Sc., LL.D., F.R.S., Faculty of Medicine, University of Western Ontario, London, Ont. (Ex-President.)
1944—Cone, William V., B.S., M.D., Montreal Neurological Institute, Montreal, Que.
1943—Cook, W. H., O.B.E., M.Sc., Ph.D., LL.D., F.A.I.C., National Research Council, Ottawa, Ont.
1946—Cowan, Ian McT., Ph.D., University of British Columbia, Vancouver, B.C.
1935—Craigie, E. Horne, Ph.D., 52 Strathgowan Ave., Toronto, Ont.
1936—Craigie, J. H., M.Sc., D.Sc., Ph.D., LL.D., F.R.S., 479 Kensington Ave., Ottawa, Ont.
1945—Crampton, E. W., B.S.A., M.Sc., Ph.D., Macdonald College, Que.
1949—Dansereau, Pierre, B.Sc.Agr., D.Sc., University of Michigan, Ann Arbor, Mich., U.S.A.
1953—Dauphinee, J. A., O.B.E., M.A., Ph.D., M.D., F.R.C.P.(C), University of Toronto, Toronto, Ont.
1952—Daviault, Lionel, B.S.A., M.Sc., D.Sc., Laval University, Quebec, Que.
1947—Dolman, Claude Ernest, M.B., B.S., D.P.H., Ph.D., M.R.C.P., University of British Columbia, Vancouver, B.C.
1938—Drayton, Frank Lisle, B.S.A., Ph.D., 333 Fairmont Ave., Ottawa, Ont.
1947—Duff, G. Lyman, M.A., M.D., Ph.D., McGill University, Montreal, Que.
1951—Dugal, L.-Paul, M.Sc., Ph.D., Laval University, Quebec, Que.
1938—Dymond, John Richardson, O.B.E., M.A., University of Toronto, Toronto, Ont.
1952—Eagles, Blythe, M.A., Ph.D., University of British Columbia, Vancouver, B.C.
1941—Ettinger, G. H., M.B.E., M.D., C.M., Queen's University, Kingston, Ont.
1948—Ferguson, J. K. W., M.B.E., M.A., M.D., University of Toronto, Toronto, Ont.
1949—Fisher, K. C., M.A., Ph.D., University of Toronto, Toronto, Ont.
1939—Foerster, R. Earle, M.A., Ph.D., Pacific Biological Station, Nanaimo, B.C.
1949—Frappier, Armand, O.B.E., M.D., L. ès Sc., F.A.P.H.A., Officier d'Académie (France), University of Montreal, Montreal, Que.
1934—Fraser, Donald T., M.C., M.B., D.P.H., Connaught Laboratories University of Toronto, Toronto, Ont.
1948—Fry, F. E. J., M.B.E., M.A., Ph.D., University of Toronto, Toronto, Ont.
1952—Gibbard, James, B.S.A., S.M., Department of National Health and Welfare, Ottawa, Ont.
1939—Gibbs, R. Darnley, M.Sc., Ph.D., F.L.S., McGill University, Montreal, Que.
1941—Goulden, C. H., M.S.A., Ph.D., Central Experimental Farm, Ottawa, Ont.
1948—Grace, N. H., M.B.E., M.A., Ph.D., Research Council of Alberta, Edmonton, Alta.
1938—Graham, Duncan Archibald, C.B.E., M.B., F.R.C.P.(C), F.R.C.P.(Lond.), 343 Lytton Boulevard, Toronto, Ont.

1951—GROVES, J. WALTON, M.A., Ph.D., Department of Agriculture, Ottawa, Ont.
1931—GUSSOW, H. T., LL.D., F.L.S., F.R.M.S., Hon. F.R.H.S., 2975 McAnally Rd., Victoria, B.C.
1944—HALL, GEORGE E., B.S.A., M.Sc., M.D., Ph.D., University of Western Ontario, London, Ont.
1951—HAM, ARTHUR W., M.B., University of Toronto, Toronto, Ont.
1944—HANNA, WILLIAM F., C.B.E., M.Sc., Ph.D., Botany and Plant Pathology, Department of Agriculture, Ottawa, Ont.
1943—HART, J. L., M.A., Ph.D., Pacific Biological Station, Nanaimo, B.C.
1947—HAYES, F. RONALD, M.A., Ph.D., Dalhousie University, Halifax, N.S.
1949—HEARD, R. D. H., M.A., Ph.D., McGill University, Montreal, Que.
1953—HEIMBURGER, C. C., M.Sc.F., Ph.D., Department of Lands and Forests, Maple, Ont.
1951—HOPKINS, JOHN W., M.Sc., Ph.D., National Research Council, Ottawa, Ont.
1917—HUNTSMAN, ARCHIBALD GOWANLOCK, M.D., University of Toronto, Toronto, Ont. (Ex-President.)
1933—HUTCHINSON, A. H., M.A., Ph.D., University of British Columbia, Vancouver, B.C.
1952—JAQUES, L. B., M.A., Ph.D., University of Saskatchewan, Saskatoon, Sask.
1950—JOHNSON, T., B.S.A., M.Sc., Ph.D., Dominion Laboratory of Plant Pathology, University of Manitoba, Winnipeg, Man.
1943—KIRK, L. E., M.S.A., Ph.D., Agricultural Organization of UN, Rome, Italy.
1950—KROTKOV, G., M.A., Ph.D., Queen's University, Kingston, Ont.
1945—LABARRE, JULES, B.Ph., L. ès Sc., D. ès Sc., University of Montreal, Montreal, Que.
1946—LARMOUR, R. K., M.Sc., Ph.D., Maple Leaf Milling Co., Toronto, Ont.
1945—LEACH, WILLIAM, M.Sc., Ph.D., D.Sc., University of Manitoba, Winnipeg, Man.
1951—LEBLOND, CHARLES P., M.D., Ph.D., McGill University, Montreal, Que.
1949—LEDINGHAM, G. A., M.Sc., Ph.D., National Research Laboratories, Saskatoon, Sask.
1940—LOCHHEAD, A. G., M.Sc., Ph.D., Department of Agriculture, Ottawa, Ont.
1932—MACALLUM, A. BRUCE, M.B., M.D., Ph.D., University of Western Ontario, London, Ont.
1924—MACKLIN, CHARLES CLIFFORD, M.B., M.D., M.A., Ph.D., University of Western Ontario, London, Ont.
1944—MAHEUX, GEORGES, M.A., M.Sc.A., D.Sc., Laval University, Quebec, Que.
1941—MAINLAND, DONALD, M.B., Ch.B., D.Sc., F.R.S.E., New York University—Bellevue Medical Center, New York, N.Y.
1931—MASSON, C. L. PIERRE, M.D., University of Montreal, Montreal, Que.
1953—MCCALLA, A. G., M.Sc., Ph.D., University of Alberta, Edmonton, Alta.
1942—MCFARLANE, W. D., M.A., Ph.D., Research Division, Canadian Breweries, Ltd., 307 Fleet St. E., Toronto, Ont.
1942—MCHENRY, E. W., M.A., Ph.D., Connaught Laboratories, University of Toronto, Toronto, Ont.
1926—MEAKINS, J. C., C.B.E., M.D.C.M., M.D., LL.D., F.A.C.P., F.R.C.P.(C), F.R.S.E., Royal Victoria Hospital, Montreal, Que.
1945—MITCHELL, CHARLES A., D.V.Sc., D.V.M., Animal Diseases Research Institute, Hull, Que.
1936—MOLONEY, P. J., O.B.E., M.A., Ph.D., Connaught Laboratories, University of Toronto, Toronto, Ont.

1938—Moorhouse, Victor Henry Kingsley, M.C., M.D., Box 568, Orangeville, Ont.
1950—Morin, J. E., M.D., M.C.R.M. (C), Laval University, Quebec, Que.
1947—Morrell, Clarence A., M.A., Ph.D., Department of Health and Welfare, Ottawa, Ont.
1938—Moss, Ezra Henry, M.A., Ph.D., University of Alberta, Edmonton, Alta.
1938—Murray, Everitt George Dunne, O.B.E., M.A., L.M.S.S.A., McGill University, Montreal, Que.
1947—Neatby, K. W., M.A., Ph.D., Department of Agriculture, Ottawa, Ont.
1945—Needler, A. W. H., O.B.E., M.A., Ph.D., Atlantic Biological Station, St. Andrews, N.B.
1942—Newton, Margaret, B.S.A., M.Sc., Ph.D., 2392 Beach Drive, Victoria, B.C.
1950—Noble, R. L., M.D., Ph.D., D.Sc., University of Western Ontario, London, Ont.
1953—Orr, J. H., M.D., C.M., F.R.C.P.(C), Queen's University, Kingston, Ont.
1935—Penfield, Wilder G., O.M., C.M.G., Litt.B., M.D., M.A., B.Sc., D.Sc., F.R.S., Montreal Neurological Institute, Montreal, Que.
1948—Pomerleau, René, B.S.A., D.Sc., Laval University, Quebec, Que.
1946—Porsild, A. E., M.B.E., B.A., National Museum, Ottawa, Ont.
1942—Préfontaine, Georges, M.D., Lic.Sc., University of Montreal, Montreal, Que.
1953—Quastel, J. H., D.Sc., Ph.D., A.R.C.S., F.C.I.C., F.R.I.C., F.R.S., McGill University, Montreal, Que.
1944—Rawson, Donald S., Ph.D., University of Saskatchewan, Saskatoon, Sask.
1932—Reed, Guilford B., O.B.E., M.A., B.Sc., Ph.D., LL.D., Queen's University, Kingston, Ont. (Ex-President.)
1942—Rousseau, Jacques, D.Sc., Jardin botanique de Montréal, Montréal, Qué.
1934—Rowan, William, D.Sc., F.Z.S., University of Alberta, Edmonton, Alta.
1939—Scott, D. A., M.A., Ph.D., F.R.S., Connaught Laboratories, University of Toronto, Toronto, Ont.
1941—Selye, Hans, M.D., Ph.D., D.Sc., University of Montreal, Montreal, Que.
1946—Shaner, Ralph F., Ph.B., Ph.D., University of Alberta, Edmonton, Alta.
1935—Sifton, Harold Boyd, M.A., Ph.D., University of Toronto, Toronto, Ont.
1940—Simard, L. C., M.D., F.R.C.P.(C), University of Montreal, Montreal, Que.
1945—Solandt, D. Y., M.A., M.D., Ph.D., University of Toronto, Toronto, Ont.
1948—Solandt, O. M., O.B.E., B.Sc., M.A., M.D., M.R.C.P., Defence Research Board, Ottawa, Ont.
1951—Speakman, H. B., D.Sc., LL.D., Ontario Research Foundation, Toronto, Ont.
1953—Strickland, E. H., M.Sc., F.E.S.A., F.A.A.E.E., University of Alberta, Edmonton, Alta.
1934—Taylor, N. B., M.D., M.R.C.S., F.R.C.S., 21 Ardwold Gate, Toronto, Ont.
1950—Templeman, W., O.B.E., B.Sc., M.A., Ph.D., Newfoundland Fisheries Research Station, St. John's, Newfoundland.
1947—Thompson, I. M., B.Sc., M.B., Ch.B., F.R.S.E., Medical College, Winnipeg, Man.
1921—Thompson, W. P., M.A., Ph.D., D.Sc., University of Saskatchewan, Saskatoon, Sask. (Ex-President.)
1949—Thompson, W. R., B.S.A., D.Sc., Ph.D., F.R.S., Commonwealth Bureau of Biological Control, Ottawa, Ont.
1936—Thomson, David L., M.A., Ph.D., McGill University, Montreal, Que.
1950—Tremblay, J.-L., B.A.Sc., D.Sc., Laval University, Quebec, Que.

1934—Wardle, R. A., M.Sc., University of Manitoba, Winnipeg, Man.
1930—Wasteneys, Hardolph, Ph.D., 20 Howland Ave., Toronto, Ont.
1943—Wynne, A. M., M.A., Ph.D., University of Toronto, Toronto, Ont.
1940—Wynne-Edwards, V. C., M.A., Marischall College, University of Aberdeen, Aberdeen, Scotland.
1935—Young, E. Gordon, M.Sc., Ph.D., Dalhousie University, Halifax, N.S.

CORRESPONDING MEMBERS

SECTION I

De Lacretelle, Jacques, de l'Académie française, Paris.

SECTION II

Siebert, Wilbur H., M.A., Ohio State University, Columbus, Ohio, U.S.A.

SECTION III

Metzler, W. A., Ph.D., F.R.S.E., Syracuse University, Syracuse, N.Y., U.S.A.

SECTION IV

Margerie, Ern. de, Director, Geological Survey of Alsace and Lorraine, Strasbourg, France.
Watts, W. W., Imperial College of Science and Technology, London, England.

SECTION V

Hanes, C. S., Ph.D., F.R.S., University of Toronto, Toronto, Ont.
Jeffrey, E. C., Harvard University, Cambridge, Mass., U.S.A.

MEDAL AWARDS

MÉDAILLE PIERRE-CHAUVEAU

1952—Pierre Daviault
1953—B. K. Sandwell, LL.D., D.C.L.

FLAVELLE MEDAL

1943—B. P. Babkin, M.D., D.Sc.
1944—V. E. Henderson, M.A., M.B., F.R.C.P.(C)
1945—R. B. Thomson, B.A.
1946—William Rowan, D.Sc., F.Z.S.
1947—G. B. Reed, O.B.E., M.A., B.Sc., Ph.D., LL.D.
1948—Margaret Newton, B.S.A., M.Sc., Ph.D.
1949—W. P. Thompson, M.A., Ph.D., D.Sc.
1950—C. H. Best, C.B.E., M.A., M.D., D.Sc., F.R.C.P.(C), F.R.S., Hon. D.Sc. (Oxon.)
1951—Wilder G. Penfield, C.M.G., Litt.B., M.D., M.A., B.Sc., D.Sc., F.R.S.
1952—A. G. Huntsman, M.D.
1953—E. G. D. Murray, O.B.E., M.A., L.M.S.S.A.

HENRY MARSHALL TORY MEDAL

1943—John L. Synge, M.A., Sc.D., F.R.S.
1944—Frank Allen, M.A., Ph.D., LL.D.
1945—Otto Maass, C.B.E. M.Sc., Ph.D., LL.D., F.R.S.
1946—John S. Foster, B.Sc., Ph.D., F.R.S.
1947—E. F. Burton, O.B.E., Ph.D.
1949—H. S. M. Coxeter, Ph.D., F.R.S.
1951—T. Thorvaldson, A.M., Ph.D.
1953—G. Herzberg, M.A., Dipl.Ing., Dr.Ing., F.R.S.

LORNE PIERCE MEDAL

1943—George H. Clarke, M.A., D.Litt., F.R.S.L.
1944—Audrey Alexandra Brown
1945—L'abbé Félix-Antoine Savard
1946—Charles N. Cochrane, M.A. (posthumously)
1947—Dorothy Livesay (Mrs. Duncan Macnair)
1948—Gabrielle Roy (Mme Carbotte)
1949—John Murray Gibbon, B.A., D. ès L.
1950—Marius Barbeau, LL.L., B.Sc., D. ès L., Dipl.Anth.
1951—E. K. Brown, B.A., D. ès L. (posthumously)
1952—Hugh MacLennan, M.A., Ph.D.
1953—Earle Birney, Ph.D.

TYRRELL MEDAL

1943—Gustave Lanctôt, D. ès L., LL.M., LL.D., D.Sc.Pol., C.R.
1944—Harold A. Innis, M.A., Ph.D.
1945—Fred Landon, M.A.
1946—A. L. Burt, M.A.
1947—A. R. M. Lower, Ph.D., LL.D.
1948—Le chanoine Lionel Groulx, Ph.D., D.Th., D. ès L.
1949—Reginald G. Trotter, M.A., Ph.D., D.C.L.
1950—John Bartlet Brebner, M.A., B.Litt., Ph.D., Litt.D.
1951—Jean Bruchési, LL.L., D.Sc.Pol., D. ès L., and
D. G. Creighton, M.A., LL.D.
1952—C. B. Sissons, LL.D.
1953—Séraphin Marion, M.A., D. ès L.

WILLET G. MILLER MEDAL

1943—Norman Levi Bowen, M.A., Ph.D., Sc.D.
1945—Morley E. Wilson, Ph.D.
1947—F. H. McLearn, B.E., Ph.D.
1949—H. V. Ellsworth, M.A., Ph.D.
1951—J. E. Hawley, M.A., Ph.D
1953—C. H. Stockwell, B.A.Sc., Ph.D.

LIST OF PRESIDENTS

1943-1944	Mgr Olivier Maurault, C.M.G., P.D., LL.D., p.S.S.
1944-1945	J. K. Robertson, M.A.
1945-1946	E. S. Moore, M.A., Ph.D.
1946-1947	Harold A. Innis, M.A., Ph.D.
1947-1948	W. P. Thompson, M.A., Ph.D., D.Sc.
1948-1949	Gustave Lanctôt, D.ès L., LL.M., LL.D., D.Sc.Pol., C.R.
1949-1950	Joseph A. Pearce, M.A., Ph.D.
1950-1951	J. J. O'Neill, M.Sc., Ph.D.
1951-1952	H. F. Angus, M.A., B.C.L., LL.D.
1952-1953	G. B. Reed, O.B.E., M.A., B.Sc., Ph.D., LL.D.
1953-1954	Jean Bruchési, LL.L., D.Sc.Pol., D. ès L.

LIST OF PRESIDENTS OF SECTIONS

SECTION I

1943-1944	Jean Bruchési
1944-1945	Maurice Hébert
1945-1946	Séraphin Marion
1946-1947	Pierre Daviault
1947-1948	Arthur Saint-Pierre
1948-1949	Léopold Houlé
1949-1950	Le chanoine Georges Robitaille
1950-1951	Donatien Frémont
1951-1952	L'abbé Arthur Maheux
1952-1953	Claude Melançon
1953-1954	Gérard Morisset

SECTION II

1943-1944	R. H. Coats
1944-1945	W. H. Alexander
1945-1946	D. C. Harvey
1946-1947	Alexander Brady
1947-1948	R. K. Gordon
1948-1949	B. K. Sandwell
1949-1950	A. G. Dorland
1950-1951	W. A. Mackintosh
1951-1952	A. S. P. Woodhouse
1952-1953	A. R. M. Lower
1953-1954	F. M. Salter

SECTION III

1943-1944	T. Thorvaldson
1944-1945	J. A. Pearce
1945-1946	C. T. Sullivan
1946-1947	E. L. Harrington
1947-1948	E. W. R. Steacie
1948-1949	J. S. Foster

1949-1950	C. S. Beals
1950-1951	H. G. Thode
1951-1952	Gerhard Herzberg
1952-1953	R. L. Jeffery
1953-1954	P. E. Gagnon

SECTION IV

1943-1944	W. A. Bell
1944-1945	J. S. De Lury
1945-1946	B. R. MacKay
1946-1947	Bruce Rose
1947-1948	F. J. Alcock
1948-1949	Victor Dolmage
1949-1950	T. L. Tanton
1950-1951	P. S. Warren
1951-1952	G. S. Hume
1952-1953	G. Hanson
1953-1954	T. H. Clark

SECTION V

1943-1944	H. S. Jackson
1944-1945	Robert Newton
1945-1946	B. P. Babkin
1946-1947	J. R. Dymond
1947-1948	E. Gordon Young
1948-1949	A. H. Hutchinson
1949-1950	T. W. M. Cameron
1950-1951	L. C. Simard
1951-1952	C. L. Huskins
1952-1953	W. A. Clemens
1953-1954	R. D. Gibbs

ASSOCIATED ORGANIZATIONS

The Canadian Institute of Mining and Metallurgy

THE ROYAL SOCIETY OF CANADA

REPORT OF THE HONORARY SECRETARY FOR THE YEAR 1952-53

COUNCIL MEETINGS

The Council met three times during the year to conduct the affairs of the Society. The Report of Council presented to the seventy-second annual meeting of the Royal Society of Canada contains a complete account of the year's business.

The Sections recommended the election of twenty-eight Fellows. Their names, and the Sections to which they were elected, appear under "Annual Meeting."

Six medal awards were made by the Society:

Médaille Pierre-Chauveau to Dr. B. K. Sandwell
Flavelle Medal to Dr. E. G. D. Murray
Lorne Pierce Medal to Dr. Earle Birney
Tyrrell Medal to Dr. Séraphin Marion
Willet G. Miller Medal to Dr. C. H. Stockwell
Henry Marshall Tory Medal to Dr. G. Herzberg

(Citations are given on pages 34–41.)

On the recommendation of the Scholarships Board one post-doctoral and four pre-doctoral scholarships were awarded to the following:

Michael Kirkpatrick Macklem, a post-doctoral scholarship for the study of English Literature of the Seventeenth and Eighteenth Centuries, at Princeton University.

Donald Johnson Greene, a pre-doctoral scholarship for research and study on the Conservatism of Samuel Johnson, at Columbia University.

Henry Kreisel, a pre-doctoral scholarship for the study of the Problem of Exile and Alienation in Modern Literature, at Queen Mary College, University of London.

Dr. Gavin Ince Langmuir, a pre-doctoral scholarship to continue his study of Medieval History under the direction of Dr. Taylor of Harvard University in Paris.

Maurice Héroux, a pre-doctoral scholarship for the study of "L'Opinion canadienne devant les questions internationales 1914–1945," at Georgetown University, Washington.

Two Rutherford Memorial Fellowships were awarded in co-operation with the National Research Council. They were awarded to Dr. H. E. Petch and Dr. G. M. Griffiths, both of whom will carry on research at the Cavendish Laboratory, University of Cambridge.

During the year it became necessary for the Society to appoint an Awards Committee to handle the responsibilities accepted by the Society in connection with the Canadian Government Overseas Awards. As mentioned in last year's Proceedings, the Committee on Plans had suggested to Dr. H. F. Angus, then President of the Royal Society, that he should write to the Prime Minister and propose that the Government of Canada use a portion of the blocked currency balances standing to its credit in certain European countries to provide fellowships and scholarships for Canadians who wished to study in these countries. The Committee also suggested that the Royal Society should offer to administer the scheme, in so far as the selection of candidates was concerned, if this would be of assistance to the Government.

Dr. Angus acted on this suggestion and his letter to the Prime Minister was received most sympathetically. The proposal was approved by the Cabinet and the first appropriation of $44,000 ($40,000 for fellowships and scholarships, and $4,000 for administrative costs) was included in the supplementary estimates of the Department of External Affairs. These estimates were passed by the House in June, 1952.

As finally worked out, the scheme involved three authorities (1) the Awards Office of the National Research Council, which the Government suggested should receive and check all applications; (2) the Royal Society of Canada, which was to accept full responsibility for the selection of all fellows and scholars; and (3) the Department of External Affairs, which would be responsible for all financial and travel arrangements. The Department of External Affairs also undertook to approach the governments of France, The Netherlands, and Italy and seek their approval of the proposal to spend part of Canada's blocked currency balances for scholarship purposes.

As these arrangements were not finalized until August, 1952, it was recognized that the awarding of fellowships and scholarships for the coming university term would require emergency measures. The Executive of the Royal Society met to consider this matter and it was agreed that the simplest plan would be to appoint an Awards Committee consisting of the members of the Executive itself, and as the original suggestion for awards had come from the Committee on Plans,

Dr. Lamb was added to the Awards Committee and named chairman. It was also agreed that Mr. F. T. Rosser, Director of the National Research Council's Office of Administration, and Dr. J. B. Marshall of the National Research Council's Awards Office, would be invited to attend the meetings of the Awards Committee in order to ensure the closest co-operation in the handling of applications.

Announcements, advertisements, regulations, and application forms were prepared and by September 2, the closing date of the competition, more than 250 applications had been received. Approximately 150 of these were for fellowships and 100 for scholarships. The applications were preponderantly for tenure in France. A few applicants wished to study in Italy but these could not be considered as the Italian Government had not approved the use of the balances held in that country for scholarship purposes. Four meetings were held to screen the applications between September 10 and 19. At the request of the Committee, Mr. Walter Herbert, Director of the Canada Foundation, attended all four sessions. At the final selection meeting held on September 25, each Section of the Royal Society was asked to name a representative, and the following were present by invitation: Mr. F. T. Rosser and Dr. J. B. Marshall from the National Research Council; Mr. Walter Herbert, Director of the Canada Foundation; Mr. Claude Lewis, President of the Canadian Arts Council; and Mr. E. A. Walker, representing the National Conference of Canadian Universities. After careful consideration, the Committee approved the final list of 9 fellows and 12 scholars, as follows:

Fellowships

Art
Humphrey, J. W.
Pellan, Alfred
Bice, Clare

Music
Renshaw, Rose H. (Miss)
Beaudet, Jean-Marie

Writing
Birney, E.

Mathematics
L'abbé, Maurice

Scholarships

French Literature
Forsyth, J. C.
Gillespie, J. L. (Miss)
Ménard, J.
Moore, C. H.
Stratford, P. C.
Warhaft, S.
Davies, B.

History
Saint-Pierre, L. (Miss)
Crépeau, Paul

Semitic Languages
Brown, A. R. F.

Sociology
Tremblay, M. Maurice
McBride, Irene H. (Miss)

Social Sciences and Economics
Raynauld, A.

Mathematics
Gilmore, P. D.

For the fiscal year 1953–4, the Department of External Affairs included in their estimates a sum of $115,000 for a second series of Overseas Awards and an additional $10,000 for administrative costs in Canada. The Awards Committee issued announcements of a second series of scholarships and fellowships in December, 1952, and applications were invited before the closing date of April 1, 1953. These awards were once again tenable only in France and The Netherlands.

On the closing date some 372 applications were received, 195 for fellowships and 177 for scholarships. Members of the Awards Committee held numerous meetings during April and May in order to screen the candidates in a preliminary way. At many of these sessions the Committee again enjoyed the able assistance of Mr. Walter Herbert of the Canada Foundation. The final meeting was held on May 22 and in addition to the members of the Awards Committee it was attended by Mr. Claude Lewis and Mr. R. H. Charlebois, of the Canadian Arts Council; Mr. E. A. Walker, of the National Conference of Canadian Universities; and Mr. Walter Herbert, of the Canada Foundation. This Committee agreed on the selection of 12 fellows and 16 scholars with a reserve list of several worthy candidates in both categories. The winners of the 1953–4 awards follow:

Fellowships	*Scholarships*
Art	*French Literature*
Louis Archambault	J. F. Flinn
Stanley Cosgrove	J. C. Forsyth*
Robert Lapalme	D. A. Griffiths
Goodridge Roberts	Gaston Laurion
	Jean Menard*
Music	L. H. Powers
Maurice Blackburn	
George Haddad	*History*
	H. B. Attin
French Literature	Louise St. Pierre*
C. M. Jones	
W. T. E. Kennett	*Semitic Languages*
	E. G. Clarke

*Three scholarships were renewals of awards made last autumn. No fellowships were renewed.

History
Rev. René Baudry

Writing
Rina Lasnier

Theatre
R. H. G. Orchard

Mathematics
Douglas Derry

Political Science
Fernand Dumont

Geography
Fernand Grenier

Art
George de Niverville
Joseph Plaskett

Music
Jean-Marie Yves Bedard
François Magnan

Zoology
Miles H. A. Keenleyside

The Publications Committee also held several meetings during the year. It was again decided that the funds made available to each Section for the publication of its transactions be limited to $900 for the coming year. Two more pamphlets were printed during the year, *The North Atlantic Community and NATO* by Dr. W. K. Taylor and Dr. J. A. Corry, and *The Place of Science in a World View* by Dr. S. Basterfield.

After Dr. Lamb had assumed the chairmanship of the newly formed Awards Committee, he asked to be relieved of the responsibility of chairmanship of the Planning Committee, and Council appointed Dr. T. W. M. Cameron as chairman of the Committee on Plans. This Committee had been asked to make a recommendation with regard to the continuation of the lecture tours held some years ago. The Committee recommended that in place of these lecture tours the President be invited to visit local centres he may select. This Committee also recommended the appointment of an Executive Secretary, a recommendation which was made simultaneously by the Executive Committee, and approved by Council. The increased work entailed in the office in connection with the activities of the Awards Committee justified this action and the increased grant from the federal Government will make it possible. Action is now pending on the appointment of a bilingual Executive Secretary.

There were eleven retirements; Jean Charbonneau and E. Minville, Section I; W. S. Fox, Lorne Pierce, and B. K. Sandwell, Section II; G. S. Whitby, John Satterly, and A. F. Stevenson, Section III; Wyatt Malcolm, Section IV; Robert Newton and E. M. Walker, Section V.

ANNUAL MEETING

The seventy-second annual meeting was opened in Convocation Hall, University of Western Ontario, at 10 A.M., June 1. The following Fellows registered:

SECTION I

Chauvin, Jean; Daviault, Pierre; Désy, Jean; Gauvreau, Jean-Marie; Guénette, René; Laurence, Jean-Marie; Lebel, Maurice; Lortie, Léon; Marion, Séraphin; Melançon, Claude; Plouffe, Adrien; Régis, L. M., O. P.; Roy, Antoine.

SECTION II

Alexander, Henry; Anderson, F. H.; Angus, H. F.; Bailey, A. G.; Bladen, V. W.; Britnell, G. E.; Clark, S. D.; Collin, W. E.; Dawson, C. A.; Denomy, A. J.; Dorland, A. G.; Elliott, G. A.; Flenley, Ralph; Fox, W. S.; Frye, H. N.; Harvey, D. C.; Jenness, Diamond; Keirstead, B. S.; Knox, F. A.; Landon, Fred; Logan, H. A.; Lower, A. R. M.; MacGibbon, D. A.; MacKay, R. A.; Marshall, Herbert; Masters, D. C.; McIlwraith, T. F.; Muckle, Rev. J. T.; New, C. W.; Phelps, A. L.; Pratt, E. J.; Priestley, F. E. L.; Raddall, T. H.; Raymond, W. O.; Sage, W. N.; Salter, F. M.; Sandwell, B. K.; Sissons, C. B.; Soward, F. H.; Stacey, C. P.; Stanley, Carleton; Stanley, G. F. G.; Stevenson, G. H.; Stewart, H. L.; Talman, J. J.; Taylor, K. W.; Thomson, J. S.; Timlin, Mabel F.; Underhill, F. H.; Wilson, G. E.

SECTION III

Adams, G. A.; Babbitt, J. D.; Basterfield, Steward; Beatty, Samuel; Bernstein, H. J.; Carmichael, Hugh; Coxeter, H. S. M.; Crawford, M. F.; Currie, B. W.; Davies, F. T.; Dearle, R. C.; Demers, Pierre; Elliott, L. G.; Foster, J. S.; Gagnon, P. E.; Gilchrist, Lachlan; Gray, J. A.; Hachey, H. B.; Halperin, Israel; Henderson, J. T.; Herzberg, G.; Howlett, L. E.; Jeffery, R. L.; Katz, Leon; Keys, D. A.; Kulka, M.; Laurence, G. C.; Lewis, W. B.; Macphail, M. S.; Marshall, J. S.; Mason, S. G.; McIntosh, R. L.; McKellar, Andrew; McKinley, D. W. R.; McLay, A. B.; Middleton, W. E. K.; Misener, A. D.; Munro, L. A.; Ouellet, Cyrias; Puddington, I. E.; Robinson, G. de B.; Rose, D. C.; Sargent, B. W.; Scherk, Peter; Shaw, A. Norman; Shrum, G. M.; Smith, H. G.; Spinks, J. W. T.; Steacie, E. W. R.; Thode, H. G.; Thomson, Andrew; Thorvaldson, T.; Walker, O. J.; Watson, W. H.; Welsh, H. L.; Williams, W. L. G.; Winkler, C. A.; Wyman, Max.

SECTION IV

Bostock, H. S.; Brownell, G. M.; Caley, J. F.; Douglas, G. V.; Edmunds, F. H.; Faessler, Carl; Fortier, Y. O.; Fritz, Madeleine A.; Hawley, J. E.; Henderson, J. F.; Hume, G. S.; Hurst, M. E.; Kindle, E. D.; Knight, C. W.; Lang, A. H.; Mawdsley, J. B.; Moore, E. S.; Russell, L. S.; Tanton, T. L.; Thomson, J. E.; Warren, H. V.; Warren, P. S.; Watson, J. W.; Weeks, L. J.; Wilson, Alice E.; Wilson, J. Tuzo; Wilson, M. E.

SECTION V

Anderson, J. A.; Bailey, D. L.; Bannan, M. W.; Burton, A. C.; Cameron, T. W. L.; Campbell, W. R.; Clemens, W. A.; Collip, J. B.; Cook, W. H.; Craigie, E. Horne; Dansereau, Pierre; Dauphinee, J. A.; Daviault, Lionel; Dymond, J. R.; Eagles, Blythe; Fisher, K. C.; Gibbard, James; Gibbs, R. D.; Grace, N. H.; Groves, J. W.; Hall, G. E.; Hanna, W. F.; Hart, J. L.; Heimburger, C. C.; Huntsman, A. G.; Hutchinson, A. H.; Leach, William; Lochhead, A. G.; Macklin, C. C.; Macallum, A. B.; Maheux, Georges; McCalla, A. G.; McHenry, E. W.; Mitchell, C. A.; Moorhouse, V. H. K.; Murray, E. G. D.; Neatby, K. W.; Needler, A. W. H.; Noble, R. L.; Orr, J. H.; Porsild, A. E.; Reed, G. B.; Rousseau, Jacques; Sifton, H. B.; Simard, L. C.; Thompson, I. M.; Tremblay, J.-L.; Young, E. Gordon.

The meeting was called to order by the President, Dr. G. B. Reed. Dr. Frank Stiling welcomed the Fellows of the Royal Society of Canada and visitors to the University on behalf of the President, Dr. G. E. Hall.

The President called for a motion to approve the minutes of the last annual meeting. Dr. A. R. M. Lower moved, Monsieur Claude Melançon seconded, that the minutes be accepted. CARRIED.

The election of twenty-eight new Fellows, as listed in the Report of Council, was moved by Dr. C. B. Sissons, seconded by Dr. T. H. Clark, and carried:

Jean Désy, Jean-Marie Laurence, Léon Lortie, R. P. Louis-Marie Régis, Section I; S. D. Clark, J. D. Leechman, Hugh MacLennan, D. C. Masters, F. E. L. Priestley, T. H. Raddall, W. J. Rose, George F. G. Stanley, Section II; Gordon A. Adams, Harold J. Bernstein, Israel Halperin, Marshall Kulka, Moray St. J. Macphail, John S. Marshall, Section III; Neil Campbell, Yves O. Fortier, James W. Watson, Ludlow J. Weeks, Section IV; James A. Dauphinee, Carl C. Heimburger, Arthur G. McCalla, J. H. Quastel, J. H. Orr, E. H. Strickland, Section V.

Those present were formally presented to the President by the presidents of the respective sections. They signed the Charter Book and received diplomas. Drs. Leechman, MacLennan, Rose, Campbell, Quastel, and Strickland, were absent.

Dr. Carl Faessler, Dr. Peter Scherk, and Dr. N. W. Bannan, elected 1952, signed the Charter Book and received diplomas.

The Honorary Secretary presented the Report of Council and asked that it be referred to the Sections. A motion was made by Dr. Adrien Plouffe, seconded by Dr. E. Gordon Young and carried.

The President announced the award of six Coronation Medals to the Society. The Royal Society of Canada had been chosen for this honour by the Department of the Secretary of State of Canada. The secretary of each section was asked to report the Fellow chosen in his section to the second General Meeting. It had already been decided by Council that the retiring president, Dr. G. B. Reed, be among the recipients.

The meeting adjourned at 11.25 A.M.

Sectional meetings were held on June 1, 2, and 3.

During the late afternoon of June 1 a very delightful reception was arranged by the University of Western Ontario at the London Hunt Club. In the evening the Society convened at Convocation Hall where the President, Dr. G. B. Reed, presented the medals. In the absence of Dr. Jean Bruchési, the incoming President, the Honorary Secretary, Dr. W. H. Cook, called on the President to deliver his Presidential Address, "Microbes and Men."

The second General Meeting of the Society was held at 3.00 P.M., June 3.

The Report of the General Nominating Committee was received. It was moved by Dr. A. G. Huntsman, seconded by Dr. D. C. Rose, that the report be adopted. CARRIED.

Reports were received from the Sections.

Some discussion followed the report of Section III on the point of election of Fellows. If the By-laws would not be regularized in time to affect the 1954 election of Fellows, Section III requested permission to elect ten new Fellows and Dr. Herzberg moved that this be granted. Dr. A. Norman Shaw seconded the motion. CARRIED.

Dr. Bladen then asked permission to make a motion to amend the

report of Section II and ask for permission to elect eight new Fellows in 1954. This was seconded by Dr. A. J. Denomy. CARRIED.

It was moved by Dr. N. H. Grace, seconded by Dr. R. D. Gibbs that the Report of Council, as presented to the Society, be adopted. CARRIED.

It was moved by Dr. J. R. Dymond, seconded by Dr. C. B. Sissons, that a vote of thanks be extended to:

Dr. E. G. Hall, President of the University of Western Ontario, and the Board of Governors for their kindness in affording the Society the facilities of the University for this meeting and also for their generous hospitality in entertaining Fellows and guests at a reception at the London Hunt Club.

To the members of the Women's Faculty Club for their kindness in contributing to the pleasure of the ladies attending the meeting.

The Local Committee on arrangements for their co-operation in arranging all matters for the meetings.

The mayor of the City of London for the dinner given to the Fellows of the Royal Society of Canada, their wives, visitors, and those participating in the Sectional meetings.

The President and members of the outgoing Council for their efforts in carrying on the business of the Society during the past year.

Dr. H. F. Angus moved that a telegram be dispatched to His Excellency the Governor-General of Canada requesting him to convey to Her Gracious Majesty, Queen Elizabeth II, the respectful congratulations and good wishes of the Royal Society of Canada on the occasion of Her Majesty's coronation. This was seconded by Dr. A. R. M. Lower. CARRIED.

In the absence of the new president, Dr. Jean Bruchési, the retiring president, Dr. G. B. Reed, adjourned the meeting.

At 6.30 P.M. on June 3 the City of London entertained the Fellows of the Royal Society of Canada, their wives, and all visitors at a most enjoyable dinner, in the banquet hall of the Hotel London.

An Oceanography session was held under the chairmanship of Dr. A. G. Huntsman at 8.30 Wednesday evening.

PRESENTATION OF MEDALS

Médaille Pierre-Chauveau

B. K. Sandwell

Monsieur le président:

La médaille Chauveau décernée chaque année par la section française de la Société Royale du Canada est un témoignage d'appréciation pour l'ensemble de l'œuvre d'un écrivain canadien. En l'attribuant cette année à M. B. K. Sandwell, la section I a voulu reconnaître non seulement un mérite littéraire certain, mais aussi une importante contribution à l'unité nationale.

Claude Melançon

Flavelle Medal

Everitt George Dunne Murray

Mr. President:

Professor Everitt George Dunne Murray was born in Johannesburg, South Africa, July 21, 1890. He was one of the third generation of Murrays in Africa. His father was Dr. G. A. E. Murray, famous surgeon, colourful figure, and loyal Briton, who in addition to his professional interests took part in political affairs which had as their objective maintaining British supremacy in that part of the world.

E. G. D. Murray received his early education in Africa, then, emulating his father, went to England for university training. There he entered Christ's College, Cambridge, and took the Natural Sciences Tripos, thereby receiving a firm grounding in all aspects of the field of biology. Clinical medicine was studied at St. Bartholomew's Hospital where special attention was devoted to pathology and bacteriology.

When the First World War broke out he entered the Royal Army Medical Corps and almost immediately demonstrated his efficiency as a bacteriologist. At this time cerebrospinal fever was a plague among the troops. The extensive studies that were undertaken resulted in the classic paper by Gordon and Murray on serotypes of the meningococcus. In 1916 he was sent to Mesopotamia and there saw all manner of diseases, particularly dysentery which was rampant among service men. Many strains of the causative agent of this infection were collected and later studied, and the results were published in 1918. These results form the basis of the serological classifi-

cation of the dysentery group. As if the importance of the disease had to be emphasized in the investigator's mind, Murray managed to contract the infection and had to be given leave of absence from the country. There followed a period of service on troop ships and finally a transfer to the Royal Army Medical College at Millbank. There he was placed in charge of the department where vaccines for the British Expeditionary forces were prepared. For the outstanding work conducted in this field he was awarded the O.B.E.

In 1917 Murray married Harriet Winnifred Hardwick Woods who since, but not without difficulty, has been successful in keeping him out of serious trouble if not out of mischief.

After discharge from the Army he returned to St. Bartholomew's Hospital as senior demonstrator in pathology and almost immediately was appointed research bacteriologist by the Medical Research Council and required to establish a laboratory at Milton near Cambridge. Here work was carried on until 1923 at which time he moved to the Department of Pathology, University of Cambridge; he became a Fellow of Christ's College, and a lecturer in Pathology and inaugurated at the University new teaching courses in the fields of pathology and bacteriology. As a member of numerous College and University committees, contributions were made in other fields.

During this period studies on virulence, endotoxins, and more particularly a detailed study of the meningococcus, were carried on. This culminated in the classic monograph published by the Medical Research Council in 1929. About this time Murray, together with Webb and Swann, discovered a new organism now known as the *Listeria monocytogenes*.

In 1930 he accepted the invitation of McGill University to become Professor of Bacteriology and Immunology and Chairman of the Department. Immediately training in the undergraduate field was greatly improved, an exacting honours course was established, and provision was made for training a limited number of postgraduate students. To carry out these progressive changes, Professor Murray had to limit his personal research and devote the greater part of his energies to the duties of instruction. Although this in some respects was to him an unpalatable change, it was one which those interested in the field will applaud for his department has since formed an unexcelled training ground for bacteriologists. Thereby his influence has broadened over North America and in particular has raised the standard of bacteriology throughout this country. From his department there has been an increasing flow of sound papers on the fundamental and applied aspects of bacteriology.

During the war Professor Murray served on a number of committees and commissions. In fact he gave up his university responsibilities temporarily to devote full time to some of the aspects of diseases of potential danger from a defence standpoint. The United States in particular was conscious of the great service he rendered and conferred on him the Medal of Freedom.

Professor Murray's interest in the open spaces is proverbial. His holidays are spent in the bush with pack and canoe living close to nature which he knows well and appreciates fully. Perhaps part of the reason for his easy assimilation into the life of this young country is to be found in a love of nature in all forms and an appreciation of worth no matter in what disguise it may appear.

Mr. President, it is an honour to present to you Professor E. G. D. Murray as the Flavelle Medallist.

CHARLES A. MITCHELL

HENRY MARSHALL TORY MEDAL

Gerhard Herzberg

MR. PRESIDENT:

Dr. Gerhard Herzberg, today one of Canada's leading physicists, was born in Hamburg, Germany, in 1904. He received his early training there and subsequently studied physics at the Darmstadt Institute of Technology where he obtained his Dr. Ing. degree in 1928. From 1928 to 1930 he carried out postdoctorate work at the universities of Göttingen and Bristol where he held a research studentship. In 1930 he was appointed Privatdozent (lecturer) and senior assistant in the Physics Department of the Darmstadt Institute of Technology.

Due to the then shortsighted policy of the Nazi régime toward its outstanding scientists, he was not reappointed. What appeared to be a misfortune for the Herzbergs proved fortunate for Canada. Dr. Herzberg came to the University of Saskatchewan on a Carnegie guest professorship in 1935. He later was made a research professor of Physics, a position he held until 1945.

In 1945 Dr. Herzberg was offered the post of Professor of Spectroscopy at the Yerkes Observatory, University of Chicago. Such an invitation could not reasonably be declined, but it is, nevertheless, an indication of the liking and regard the Herzbergs have for Canada that they took the first opportunity that was comparable to Dr. Herzberg's attainments to return. In 1948 he was made Principal Research Officer with the National Research Council, and in 1949, Director of the Division of Physics.

Dr. Herzberg is distinguished for his work on atomic and molecular spectra. He has contributed greatly to the determination of the structures of diatomic and polyatomic molecules. He has been prominent in the study of forbidden transitions, and has recently observed the quadrupole rotation vibration spectrum of hydrogen. He has identified CH^+ as a constituent of the interstellar medium, and has produced the nuclear bands of comets in the laboratory. His three books on atomic and molecular spectra are internationally known as standard works on the subject.

In 1939 Dr. Herzberg was elected a Fellow of the Royal Society of Canada; in 1950 he received the Médaille de l'Université, Liège, Belgium; and in 1951 he was made a Fellow of the Royal Society, London.

There is more to be said than this. Dr. and Mrs. Herzberg grew up in an old and proud culture. They had attained a place of eminence and prestige in that culture. What was, for them, an unfortunate turn of the wheel brought them to Canada, a new and growing country; a country which, according to the writings and speeches of my good friend Professor Lower, has not yet worked out a distinct cultural pattern. The Herzbergs did not complain. They saw much to admire in this new and growing country. Where they could not admire they were tolerant, sympathetic, and helpful.

Mr. President, the Fellows of Section III have no alternative to naming Dr. Herzberg as deserving of the highest recognition for his outstanding work as a scientist, because of his fine personal qualities, his sincere modesty in regard to his own achievements, and because he is a downright good fellow. It gives the members of Section III the utmost satisfaction to present you, Dr. Herzberg, for the Henry Marshall Tory Medal.

R. L. JEFFERY

LORNE PIERCE MEDAL

Alfred Earle Birney

MR. PRESIDENT:

The Lorne Pierce Medal has traditionally been awarded to a Canadian author whose critical or creative writing notably succeeds in interpreting Canadian life to the Canadian people. It has not necessarily been given for any one book or for the publications of any one year but has rather signalized the cumulative merit of a writer who has given to his fellows some measure of that rich self-consciousness and self-understanding which belong to a cultural

heritage. This year the Society has chosen Alfred Earle Birney to be the recipient of the award. That Dr. Birney is unable to be present today is by no means inauspicious for he is during these months enjoying in the south of France an unaccustomed freedom to devote all his energies to creative writing, having received a Canadian Government fellowship to that end.

In the last decade Earle Birney has contributed much both to imaginative creation and to critical evaluation, in Canada. Through his editing of *Canadian Poetry*, through various forms of literary expression—poetry, the novel, radio drama—he has striven to enlarge our apprehension of the Canadian psyche and has enriched and strengthened Canadian currents of thought. And he has consistently, by example and by precept, by formal teaching and friendly encouragement, impelled others to make use of their talents to the same purpose.

In such volumes of poetry as *David* and *The Strait of Anian* he has shown a great sensitivity in his interpretations of nature and man's place in nature and he has touched acutely upon the problems that arise out of the crises of depression and war. By the use of symbol and image, by a felicity of language and rhythm, he has impressed the quality of his vision upon the minds of his many readers. The choice of his subjects has ranged from the large public event to the significant private experience; his tone has run the gamut from biting satire to pure lyricism; his techniques have included metaphysical imagery and Anglo-Saxon versification.

In *Turvey*—certainly one of the most successful Canadian post-war studies in fictional form—Birney has portrayed with vast humour and in great good humour the experiences of the well-intentioned little man caught in the complications of army organization and government administration. In Turvey we find the Canadian Schweik; and we find ourselves.

In his striking and original radio drama, *Trial of a City*, Birney has portrayed with rich philosophical innuendo and with fine poetic feeling the pangs of a young, growing and vigorous city, caught in the shifting web of rapid change and afflicted by the grasping desires of those who seek to make its power and beauty subserve their own ends.

In all of his writing—in prose and in poetry alike—he has shown a constant willingness to experiment and to grow; yet he has at the same time imposed upon himself a rigorous and effective discipline which has given to the best of his work the brilliance and durability of a classic expression.

I have much pleasure, Mr. President, in presenting Dr. Birney for the award of the Lorne Pierce Medal.

J. R. DANIELLS

Tyrrell Medal

Séraphin Marion

Monsieur le président:

Peu d'écrivains, autant que monsieur Séraphin Marion, appartiennent à la Capitale canadienne. Il y est né; il y a parcouru le cycle complet des études secondaires et universitaires; il y a rempli une carrière toute de fruits et d'honneur.

A peine est-il bachelier ès arts qu'un grand ami de la famille—l'auteur qu'immortalisera le *Dictionnaire général de l'histoire du Canada*—le dirige vers la Sorbonne. Il y va, en suit les cours, et devient l'un de ses docteurs ès lettres.

Quelques années durant, il enseigne le français au collège militaire de Kingston. En 1925 il entre aux Archives nationales, où il se dépensera jusqu'à ce que, dernièrement, certains prodromes l'avertissent d'avoir à diminuer ses charges et sa vitesse.

L'important dans la vie de monsieur Marion, c'est l'orientation qu'il a su donner à ses énergies non engagées, si j'ose ainsi dire. Radiesthésiste heureux, il a frappé la source d'où s'alimenteraient indéfiniment son esprit et ses productions littéraires et historiques. Les papiers jaunis de notre passé, les journaux maculés qui dorment en paix sous les couches d'une poussière morne et durcie, il les a tirés de leurs ténèbres, il les a fréquentés, il les a pressés pour en extraire la rarissime moelle dont ils sont les receleurs. A ce jeu, il lui est arrivé de trahir quelques-uns de ses secrets les plus intimes. On aurait pu croire que *La Querelle des Humanistes canadiens au XIXe siècle* et *La Bataille romantique au Canada français* eussent dû éveiller les intellectuels de chez nous, toujours hélas ! un peu somnolents. S'il n'en fut rien, ou presque rien, serait-ce que les sujets traités se prêtent mal aux discussions paisibles ? A nous d'y voir dans *Les Lettres canadiennes d'autrefois* — sept volumes contenant une énorme masse de renseignements que nous ignorions en partie, et qu'il nous importe de connaître en entier si nous voulons, autrement que par sauts ou dans un clair-obscur sans art, suivre l'évolution des courants d'idées et des graves problèmes de nos devanciers.

Le fait de s'être livré avec la constance d'un bénédictin à l'exploration discrète et laborieuse de notre littérature naissante mériterait seul la récompense qu'une association royale ne décerne qu'à ses membres les plus insignes. Mais notre collègue a bien d'autres crédits à son compte. Pendant de longues années il a servi généreusement et notre Section française et notre Société toute entière. Il a besogné ferme au Secrétariat général; à plusieurs reprises, sur demande du Conseil d'Administration il a rempli des tâches délicates auprès des

premiers ministres de nos provinces; et jamais, à nos réunions, il ne s'est présenté sans quelques-unes des plus belles pages de ses travaux.

Tant de dévouement effectif, une œuvre écrite si considérable ne sauraient ne pas attirer l'attention. Aussi notre Société, toujours soucieuse de couronner les valeurs authentiques, a-t-elle cru bon d'attribuer à monsieur Séraphin Marion l'une des plus hautes distinctions dont elle dispose annuellement. Noble geste, à coup sûr, que personne ne désavouera parmi les admirateurs et les amis nombreux du récipiendaire.

GEORGES SIMARD, O.M.I.

WILLET G. MILLER MEDAL

Clifford Howard Stockwell

MR. PRESIDENT:

Dr. Stockwell, from his years as a student in 1925, has carried on research in a wide variety of geological subjects. These have included both broad studies of general application and others of intricate detail. They lie in the fields of Mineralogy, Structural Geology, Petrology, and Stratigraphy, and the results have been published in many scientific papers, reports, and memoirs.

His earliest publication, "Galena Hill, Mayo District, Yukon," written while a graduate student, set a standard for thoroughness of detail and correctness of deduction that has been notable throughout all his work. This study of an area, on which the attention of many geologists has since been focused, remains unchallenged.

Among his researches in Mineralogy his paper on "The X-ray Study of the Garnet Group," published in 1927, won him early recognition and was an important step in the understanding of the crystal structure of these minerals.

His work on "The Genesis of Pegmatites of Southwest Manitoba" published by our Society in 1933 has received acclaim by specialists in this field, and his publications on "The Chromite Deposits of the Eastern Townships, Quebec," and on "The Gold Deposits of Herb Lake Area," and "The Rice Lake-Gold Lake Area," in Manitoba, illustrate his outstanding, more general, geological studies.

In addition to these researches, Dr. Stockwell has distinguished himself in the field of exploration. In the summer of 1932, he travelled with a small party by canoe through the unexplored region north of Great Slave Lake. By this work he delineated the basic features and problems of the geology of this large part of the Precambrian Shield,

and laid the foundation for the more detailed studies that have followed.

In recent years his studies have centred on Structural Geology and, in particular, on the structural controls of mineral deposits. His paper, "The Use of Plunge in the Construction of Cross Sections of Folds," published in 1950, is notable for its original approach to the problem.

Recognition of his ability brought Dr. Stockwell an invitation to undertake fundamental research on the great Franklin Furnace mineral deposits, from which study he has recently returned to the staff of the Geological Survey of Canada.

Mr. President, I have the honour to present Dr. Clifford Stockwell as recipient of the Willet G. Miller Medal of our Society in recognition of his researches in the Geological Sciences.

T. H. Clark

REPORTS OF SECTIONS

Rapport de la Section I

La Section I a tenu cinq séances d'études auxquelles ont assisté treize membres: MM. Claude Melançon, Pierre Daviault, Jean Marie Gauvreau, Léon Lortie, Jean Chauvin, Adrien Plouffe, Maurice Lebel, Rév. Père Régis, Jean-Marie Laurence, Jean Désy, René Guénette, Antoine Roy, Séraphin Marion.

Une séance conjointe avec la Section II a été consacrée à l'étude de l'enseignement du français dans les provinces anglaises et de l'enseignement de l'anglais dans la Province de Québec.

La Section I a consacré une séance d'étude à l'expédition des affaires courantes et pris connaissance de quinze mémoires, lus en tout ou en partie.

La Section réitère que les rapports ou les mémoires de la Société devraient toujours comporter sur la couverture des inscriptions bilingues.

Il est proposé par M. Jean Désy, appuyé par M. Jean Chauvin que M. Esdras Minville soit rayé des cadres et que la mise à la retraite de M. Jean Charbonneau soit acceptée.

La Section I prie le Conseil Général de déclarer deux fauteuils vacants pour 1953, et de décerner la médaille du couronnement à M. Claude Melançon, président sortant de charge. A la suite du Conseil Général, la Section I désire souligner l'excellent travail accompli par M. Pierre Daviault comme membre du Comité des bourses du Gouvernement Fédéral.

Les élections ont donné les résultats suivants:

Président : M. Gérard Morisset
Vice-Président : M. Jean Chauvin
Secrétaire : M. J.-M. Gauvreau (onzième terme)
Editeur : Dr Adrien Plouffe
Représentant additionnel au Conseil : M. Claude Melançon
Comité des nominations : MM. Claude Melançon et Antoine Roy
Comité de la médaille Chauveau : MM. Morisset, Gauvreau, Chauvin, Bruchési, Sylvestre, Melançon
Comité de la médaille Lorne Pierce : MM. Morisset, Chauvin, Roy
Comité de la médaille Tyrrell : MM. Morisset, Chauvin, Roy
Comité Général des bourses : M. l'abbé Arthur Maheux

Comité des candidatures : MM. Morisset, Chauvin, Gauvreau, Roy, Daviault, Robidoux, Lebel
Comité des bourses de la Section : M. Lebel, Mgr Maurault, R.P. Lévesque, MM. Bruchési, Sylvestre
Comité du programme : MM. Morisset, Chauvin, Gauvreau
Comité de lecture : MM. Plouffe, Lorrain, Frémont

M. Le Président Jean-Marie Gauvreau propose, appuyé par M. Antoine Roy, que le rapport de la Section I soit adopté.

Report of Section II

Section II held six meetings at two of which business of the section was transacted. Fifty members attended, and there were many visitors. In addition to the President's Address, thirteen papers were read in full or in part. Special features were the Symposium on Canadian Aid to Underdeveloped Countries, and the Joint Session with Section I on English and French Studies in French and English Canada.

The following officers and committees were elected:
President: F. M. Salter
Vice-President: D. A. MacGibbon
Secretary: V. W. Bladen
Additional member of Council: Carleton Stanley
General Nominating Committee: C. A. Dawson, W. O. Raymond
Medal Committees:
Lorne Pierce Medal: F. M. Salter, D. A. MacGibbon, A. L. Phelps
Tyrrell Medal: F. M. Salter, D. A. MacGibbon, F. H. Underhill
Selection Committee: D. A. MacGibbon (*Chairman*), F. M. Salter, J. S. Thomson, W. N. Sage, C. B. Sissons, V. W. Bladen
Scholarship Committee: J. A. Corry (*Chairman*), W. Kaye Lamb, D. C. Harvey
Programme and Editorial Committee: Carleton Stanley (*Chairman*), H. N. Frye, B. S. Keirstead, R. Flenley, V. W. Bladen

The Report of Council was approved.

The Section noted with deep regret the deaths of W. C. Clark, G. H. Clarke, J. M. Gibbon, H. A. Innis.

The Section was informed that the following had requested transfer to the retired list and that Council had agreed to the transfer: W. S.

Fox, Lorne Pierce, B. K. Sandwell. The Section expressed the hope that these gentlemen might still occasionally participate in the meetings of the Section. The Section asks that retired fellows be kept on the mailing list and receive information about the activities of the Society, and in particular the programme. The Section recommended that one Coronation Medal be awarded to the President, A. R. M. Lower. The Section asks permission to elect eight Fellows in 1954.

Report of Section III

The Section held two business meetings and a total of ten scientific sessions at which approximately 90 of the 124 papers listed on the programme were presented.

The Section regrets the death of one of its Fellows Dr. H. F. Dawes. It also notes with regret the transfer to the retired list of Dr. H. S. Whitby, Dr. F. Stevenson, and Dr. J. Satterly.

Forty-five Fellows and twelve visitors signed the attendance book of the Section.

The following officers and committee members were elected:

President: Dr. P. E. Gagnon
Vice-President: Dr. R. M. Petrie
Secretary: Dr. D. C. Rose
Additional Member of Council: the retiring President, Dr. R. L. Jeffery
Tory Medal Committee: Since no award will be made next year no new nomination was presented.
Committee on the Selection of New Fellows: Dr. J. W. T. Spinks, Dr. W. L. G. Williams, Dr. W. H. Watson, and the Officers of the Section
Editorial Committee: Dr. D. A. Keys (*Chairman*), Dr. R. L. Jeffery, Dr. C. Coffin
Editorial Board for the Canadian Journals of Research: The present representatives were re-elected: Dr. G. A. Volkoff, Dr. T. Thorvaldson
Members of the General Nominating Committee: Dr. P. E. Gagnon (1 year), Dr. R. M. Petrie (2 years)
Committee for Award of Royal Society of Canada Research Scholarships: Dr. S. Beatty (*Chairman*), Dr. D. J. LeRoy (2 years), Dr. J. S. Foster (3 years), Dr. C. S. Beals (4 years)

The Section formally accepted the Report of the Council.

The Section decided to ask for permission to elect ten new Fellows in 1954, if necessary by suspending the by-law to do so. A motion to this effect will be presented at this meeting.

At the request of the General Meeting on June 1, the Section suggests the presidents of Sections would be suitable recipients for the Coronation Medal and nominates Dr. R. L. Jeffery from Section III.

This report was accepted at the General Meeting of the Society on the afternoon of June 3.

Report of Section IV

Section IV held four sessions, attended by more than forty Fellows and guests. Four new Fellows, N. Campbell, Y. O. Fortier, W. J. Watson, and L. J. Weeks were elected. Four Fellows were presented at the General Meeting, namely, Fortier, Watson, Weeks, and Faessler. Campbell was not able to be present owing to ill health. Faessler, who was in Europe during the meeting when he was elected last year, attended this meeting and was presented.

The following officers and representatives were elected for the Section:

President: T. H. Clark

Vice-President: J. B. Mawdsley

Secretary: H. S. Bostock

Additional Member of Council: G. Hanson

Representatives of Section IV to the General Nominating Committee: J. E. Hawley (for one year), E. S. Moore (for two years)

Editorial Committee: T. H. Clark (*Chairman*) and other Fellows associated with McGill University for this meeting and the Transactions of 1953. For 1954 the Editorial Committee will be formed from the Fellows in the Geological Survey of Canada, G. S. Hume, *Chairman.*

Committee on Nominations to Section IV: I. W. Jones (*Chairman*) P. S. Warren, G. M. Brownell, J. F. Henderson, A. W. Jolliffe, H. V. Warren, H. S. Bostock

Willet G. Miller Medal Committee (This Committee will stand for two years to decide the award in 1955): J. E. Gill (*Chairman*), R. T. D. Wickenden, J. E. Hawley, A. E. Wilson, L. S. Russell

Representatives from Section IV for the Royal Society of Canada Fellowship Committee: H. C. Cooke (*Chairman*), R. P. D. Graham, E. S. Moore

Section IV proposes to elect and recommend to the Society four new Fellows for 1954.

The request by Wyatt Malcolm to be placed on the retired list is accepted and recommended to Council.

A resolution was passed that the Coronation Medal to be allotted by Section IV should be awarded to J. B. Tyrrell.

Section IV accepts the report of Council.

It was moved by H. S. Bostock, seconded by A. H. Lang, that this report be received. CARRIED.

REPORT OF SECTION V

A large number of Fellows and guests were in attendance at the meetings of the Section. Fifty-four papers were presented, several of these by title.

Section V held two business meetings. It met as a whole on Monday afternoon for the Presidential Address by Dr. W. A. Clemens who spoke on "Some Fundamental Problems in the Biology of Pacific Salmon," for the Flavelle Medal Address by Dr. E. G. D. Murray on the "*Story of Listeria*" and for two papers of general interest.

On Tuesday morning the whole section devoted its attention to a symposium of four invitation papers on the subject "Recent Approaches to the Control of Diseases and Pests in Plant and Animal Life." The Section then divided and met in sub-sections on Botany and Zoology, and on Physiology and Medical sciences Tuesday afternoon and Wednesday morning and afternoon. Many members visited the Science Service Laboratories and enjoyed the hospitality accorded there.

Six Fellows were elected this year and the Section requests permission to elect six Fellows in the session 1953–4. The decision to ask for permission to elect only six Fellows in 1954 was made with considerable reluctance as a preliminary and as yet incomplete survey of biological staffs in Canada had revealed upwards of nine hundred persons of the rank of Assistant professor or higher, barely 8 per cent of whom are Fellows of Section V. Further, the files of Section V contain the names of a large number of nominees, many of whom are persons of outstanding eminence. However, since the Committee of Council on organization has the whole question under study and expects to bring down a report in 1954, Section V decided that further action as to numbers of Fellows elected should await completion of the present survey, and presentation of the report to Council. In order to facilitate this, the Section established a committee to continue the

survey of potential fellows in the biological sciences, which would provide required comparative information for the Council's Committee on organization and make available helpful information to the Sectional Selection Committee.

The Section accepted the report of Council and recommends that the six special Coronation Medals be given to the President of the Society and to the Presidents of each Section. If this is not generally agreeable this Section recommends that the Medal for the biological sciences be given to the President of this year, Dr. W. A. Clemens.

Notice was taken of the transfer of Dr. Robert Newton and Dr. E. M. Walker to the retired list and of a recent high honour, namely, the bestowal of the Order of Merit upon Dr. Wilder G. Penfield, one of its Fellows.

The following officers and committee members were elected for the 1953–4 session:

President: R. D. GIBBS
Vice-President: E. G. D. MURRAY
Secretary: N. H. GRACE
Representatives on the General Nominating Committee: J. B. COLLIP, A. G. HUNTSMAN
Editorial Committee: E. HORNE CRAIGIE (*Chairman*), H. B. SIFTON, and L. C. SIMARD
Scholarships Committee: D. L. THOMSON (*Chairman*), J. R. DYMOND, W. LEACH, and BLYTHE EAGLES
Selection Committee: To retire in 1954, R. E. FOERSTER, E. GORDON YOUNG; To retire in 1955, G. MAHEUX (*Chairman*), E. G. D. MURRAY; To retire in 1956, A. G. MCCALLA, A. G. LOCHHEAD, and the Secretary
Flavelle Medal Committee: To retire in 1954, C. H. BEST, W. F. HANNA (*Chairman*), A. W. H. NEEDLER; To retire in 1955, J. R. DYMOND, R. L. NOBLE, R. POMERLEAU
Additional Member of Council: W. A. CLEMENS
Representatives to the Editorial Board of the Canadian Journals of Research: To retire in 1954, D. L. BAILEY and E. HORNE CRAIGIE
Programme Committee: J. W. GROVES (*Chairman*), L. P. DUGAL, W. LEACH (with powers to add)

It was moved by N. H. Grace, seconded by J. R. Dymond, that this report be accepted. CARRIED.

APPENDIX A

PRESIDENTIAL ADDRESS

PROCEEDINGS OF THE ROYAL SOCIETY OF CANADA

VOLUME XLVII : SERIES III : JUNE, 1953

PRESIDENTIAL ADDRESS

Microbes and Man

G. B. REED, F.R.S.C.

MAN has always lived in close association with microbes as did his ancestors. Some are not unfriendly and are always with us, others cause mild to serious disturbances in man's activity, and still others are deadly. Microbes have been known as the causal agents of infectious diseases only for the last seventy-five years, but there are ample evidences of their activity in historical records of infectious diseases and still earlier records in mummified bodies. During the last ten years control of microbes parasitic in man and animals has entered a new phase of development with near revolutionary force. Since penicillin, streptomycin, aeromycin, and other antibiotic names have become household words, the subject is not unfamiliar. Sooner or later microbes play an important part in all our lives and some analysis of the significance and limitations of this radical development may be of interest to poets and historians as well as to professional bacteriologists.

The great epidemics which have swept around the world time after time—epidemics of plague, cholera, smallpox, typhus, typhoid, tuberculosis, yellow fever, to name but a few—testify to the vitality of these lowly forms of life. Wars have been lost, great cultures have collapsed, the course of human history has been altered by the intervention of these minute parasites. Man's history is studded with examples of such intervention by microbes.

The struggle with microbes was long a struggle against the unknown. Progress was slow and indefinite, but progress was made. Man early learned to shun the leper; the leper was "unclean," he was in fact a source of microbes. Many similar procedures were gradually adopted to keep the victims of epidemics isolated. Plague spots were cut off from contact with surrounding areas. Many curious devices were used, such as the "plague stones," hollowed out stones placed on the outskirts of stricken villages where people might leave orders for supplies which would later be filled by bold tradesmen from the outside. The Romans built great aqueducts unaware of the fact that the pure water they sought was purity from waterborne microbes.

It was early recognized that the victims of epidemics who recovered were immune, for longer or shorter periods, to a subsequent attack. In some regions it was customary, when an epidemic disease such as smallpox occurred in relatively mild form, to deliberately expose children that they might contract the disease and gain immunity. A century before the microbe of smallpox was recognized, a vaccine was developed which provided immunity in a much less drastic manner. The present-day smallpox vaccine is based on the principle of this early development.

With knowledge of the causal organisms of infectious diseases progress was much more rapid. Two general approaches to the control of microbes were made. In general terms: one method has been concerned with the destruction of microbes outside the body or with the erection of barriers which hinder their spread and contact with man; the second method has been concerned with immunity. These procedures have sharp limitations but over the last fifty to seventy-five years there have been many conspicuous and dramatic successes. Some of these procedures are now so much a part of everyday life that their importance is overlooked.

As far back as there are reliable historical records typhoid and related fevers were among the major causes of morbidity and mortality. A knowledge of the causal microbes, the manner in which they leave the diseased body, spread via sewage to water supplies and from water supplies to man made it apparent that sewage disposal and water purification would provide a means of interrupting the chain of events. Engineering works are providing us with water supplies free of the typhoid group of microbes. Where these measures have been introduced and rigidly controlled typhoid fever has been almost eliminated. A typhoid epidemic is now a matter of criminal negligence. A major cause of disease and death up to thirty years ago is now almost forgotten in the more favoured regions of the world. Many other examples might be quoted to indicate what has been done over the last fifty years to keep parasitic microbes out of contact with man.

More extensive control has been effected by immunization. In Thucydides' history of the Peleponnesian Wars, where the plague of Athens is described, it is noted that most of those stricken died utterly neglected. Experience soon indicated that it was almost certain death for a healthy person to nurse a plague victim. The only nurses were those who had recovered from the plague, "for the same person was never attacked twice, never at least fatally."

During the last sixty years a long series of highly successful procedures has been developed to bring about immunization by less drastic

measures than an attack of the microbe infection. One of the most successful is in the case of diphtheria. Forty years ago horses were immunized with sublethal doses of the toxin produced by the diphtheria microbe. This results in a modification of the synthesis of blood serum globulin with the formation of antibody globulin, diphtheria antitoxin, a substance capable of neutralizing the diphtheria toxin. The antitoxin, partly purified from the immune horse blood, is used in the treatment of diphtheria. The end result of this procedure was a marked decrease in the mortality from the disease, but the case incidence remained high. Twenty years ago, another type of immunization was developed, diphtheria toxoid. The toxin produced by the diphtheria bacillus is chemically modified; this modification renders the material non-toxic but leaves intact the property of stimulating the formation of antibodies. With this material healthy children are actively immunized and the result of the widespread use of toxoid immunization has been to lower greatly the incidence of diphtheria. Thirty years ago I was in charge of a diagnostic laboratory where almost half my time was devoted to the identification of diphtheria microbes; at present we are generally unable to find cases for our teaching laboratories. This has been the history in all countries where the immunization procedure has been applied. Many other instances of active immunity are familiar.

A considerable group of microbes has so far eluded these methods of control. No efficient method is available to adequately prevent their spread or contact with man; no satisfactory method of immunization has been devised; in other instances, where immunization is possible, the particular microbe does not occur in man with sufficient frequency to justify general immunization. A number of these elusive microbes have been well controlled by the new chemotherapeutic agents and particularly by the antibiotics.

This new approach has in reality been almost a century in the making. It began eighty-six years ago in the Edinburgh Infirmary when James Lister turned a microscope on the exudate of septic surgical wounds. The microscope revealed that the septic exudates were teeming with microbes, bacteria. This was the first direct evidence of the role of microbes in a disease process. But at the same time that Lister advanced proof of the cause of the disease he announced a cure. The cause of sepsis was a microbe and the proposed cure, what Lister called an antiseptic, an agent which destroyed the causal microbe in the body tissue.

The introduction of antiseptics revolutionized surgery and started that field of medicine on its formal expansion. It was recognized almost at once, however, that the use of antiseptics introduced a most serious

problem, a problem which proved insurmountable for three-quarters of a century: the antiseptics were themselves highly toxic for animal tissues. The surgeons in large part evaded the problem by the development of aseptic surgery, they introduced sterile technique. Instead of attempting to kill microbes with antiseptics they prohibited the introduction of microbes.

But in the two decades following Lister, as it became known that infectious diseases in general resulted from the invasion of the body by microbes, the problem was compounded. Especially in infections like typhoid fever, where the microbes invade almost every tissue of the body, it was impossible to apply a toxic antiseptic. The effects of the antiseptic were likely to be worse than the effects of the microbes.

So the search went on for better antiseptics. The requirement was a substance highly toxic for parasitic microbes, but not toxic for animal tissues or the animal as a whole. For decades the search seemed nearly hopeless. After all, it was argued, the problem concerns living matter and what is toxic for microbe protoplasm is likely also to be toxic for animal cell protoplasm. The solution of the problem seemed so remote that major effort was turned to other methods of microbe control. This was most fortunate for out of the work emerged the long series of measures, examples of which I have just reviewed.

A few hardy investigators, however, continued to search for the ideal antiseptic. The first conspicuous success was with the protozoon malaria microbe. South American Indians treated malaria with the bark of the cinchona tree. Quinine was prepared from this bark and this quinine in adequate doses destroys the malaria microbe without seriously injuring human tissues. In other words here was a compound toxic for a microbe but not toxic for man. Soon there followed other chemotherapeutic agents for protozoon microbes: African sleeping sickness, amoebic dysentry, syphilis, and a few other diseases. Not only were these compounds of outstanding value in the control of particular microbes but the results demonstrated that there are fundamental differences between microbe protoplasm and animal tissue protoplasm, that a substance poisonous to the former may be harmless to the latter. The search for anti-bacterial and anti-viral agents continued with renewed effort.

Of the thousands of naturally occurring and synthetic compounds investigated one of the more promising groups of anti-bacterial agents was the aniline dyes. Twenty years ago Dgomak in Germany found that a newly synthesized geranium red dye was highly toxic for certain species of bacteria and of very low toxicity in the animal body. A few years later it was shown that a colourless compound, sulphanilamide,

may be split off from the dye—a compound which exhibits the toxic properties of the original dye for certain microbes and, like the dye, is of low toxicity for man. When introduced into the body, this substance is rapidly distributed through all the tissues. It is generally possible to introduce enough, without seriously interfering with normal body functioning, to provide in the tissues a toxic concentration for those microbes sensitive to its action. Sulphanilamide and a group of substitution compounds came into wide use in the later 1930's and proved to be of great value in controlling the activity of certain microbes in man. For example, early in the last war it was shown in my laboratory that these compounds when introduced into infected wounds destroyed gas gangrene bacilli.

The activity of the sulphanilamides demonstrated still more strongly that the non-toxic antiseptic of Lister's initial search was within the range of possibility if indeed it had not been found. At least a series of microbes was destroyed in man's body by minute concentrations of these compounds while body functions were not seriously affected.

Work on the sulphanilamides in the late 1930's activated the opening up of another vista—a vista which those of us familiar with the background should have recognized years before. The discovery of antibiotics stems from long-standing knowledge that microbes growing together are sometimes antagonistic. Several years ago Sir Alexander Flemming made practical use of the antagonism exercised by a blue mould of the genus *Penicillium* on certain types of bacteria. From cultures of a particular strain of *Penicillium*, Flemming extracted the active principal which he called penicillin. This extract, lethal in the test tube for some types of microbes and non-toxic for other types, proved to be a valuable laboratory reagent.

In 1940 Sir Howard Florey at Oxford demonstrated that penicillin was also lethal for certain microbes growing in the body of the white mouse and that relatively large amounts were harmless to the animal. He injected the penicillin into groups of mice infected with fatal doses of haemolytic streptococcis, one of the important microbes of man. The penicillin-treated mice recovered, the untreated died of the infection. This simple experiment opened a vast expanse of possibilities. More elaborate trials immediately followed, including experiments on human cases of infection with microbes known to be sensitive to penicillin in the test tube. Results supported the original simple experiment.

Only minute amounts of the material were in existence and means of production in quantity seemed impossible at the time. Two lines of approach developed rapidly, the first an attempt to synthesize penicillin.

Much progress has been made but it has not been possible to imitate exactly the synthetic process which goes on in the mould cell. The second approach was like a problem in field agriculture: to improve the plant by genetical means, to improve the fertility of the environment, and finally to recover the active material in chemically pure form. This approach has been eminently successful. Within three to four years after Florey's beautifully simple experiments large quantities of penicillin were being produced in Britain, the United States and Canada and a little later in many parts of the world.

It was at once apparent that if *Penicillium notatum*, Flemming's original mould, produces a substance of these outstanding characteristics other species of mould might produce more or better antibiotics and there are thousands of species. It was equally apparent that other micro-organisms or cells of higher forms might also yield antibiotics. In the last ten years thousands of species of moulds, bacteria, algae and higher plants have been investigated from this point of view and the work is only well under way. In my own laboratory half a dozen species of moulds, several species of bacteria and a species of blue green algae are showing promising results. This is characteristic of half the bacteriology laboratories throughout the world.

Of the many species investigated a large number have yielded antibiotic substances antagonistic for certain of the parasitic microbes which invade man. The majority, however, have proved valueless. Some are highly toxic for human tissues as well as for certain microbes, others are toxic for microbes in the test tube but not toxic in the body environment. Of the many which exhibited early promise less than a dozen have proved to be of value in man.

This is not simply a search for better antibiotics but rather a search for antibiotics antagonistic to microbes which are resistant to those presently available. Penicillin, for example, is not active against the tuberculosis microbe, streptomycin is moderately active, a still more active one is urgently required. In my own laboratory we recently prepared a very different antibiotic from a bacterium. It is now showing promise in tuberculous guinea pigs and rabbits. But the road from early animal trials to the treatment of a microbe infected man is long and tortuous.

It is too early to attempt to assess the results of this eight to ten years' use of antibiotics and much more difficult to estimate the value of the wider range of antibiotics which will be available during the next ten years. It is, however, recognized that a number of microbes which produced serious disease in man are better controlled by antibiotics than by any other agency. This is particularly true of bacterial

pneumonia, many of the streptococcus infections, gonorrhoea, syphilis, and meningitis.

For the bacteriologist the advent of antibiotics has probably raised more problems than it has solved. Why, for example, are trace amounts of these antibiotic compounds highly toxic to certain species of microbes and non-toxic for other species and non-toxic to animal or human tissue cells? In the case of penicillin, for example, it was found that sensitive bacteria in the presence of the antibiotic are unable to take up glutamic acid, an essential nutrient for these organisms. It was postulated that those microbes or other cells which require glutamic acid are inhibited or destroyed by penicillin while microbes or tissue cells which do not require glutamic acid, or are able to synthesize it, are not harmed by penicillin. This is by no means a complete story, for in penicillin-sensitive microbes the antibiotic inhibits the uptake of other substances in addition to glutamic acid, various substances already in the microbe cell are not retained, and the cell fails to develop or dies. But how does the antibiotic inhibit this uptake? The answer is complex and not completely known.

It is apparent that the trace amounts of antibiotic combine with an essential constituent or constituents of the sensitive cell. The most probable cell constituents with which the antibiotic might make a destructive combination are certain enzymes. In every living functioning cell from the microbe to the most complex human tissue cell, there are many chain reactions, one reaction depending upon the products of a previous and different reaction. Each is activated by a specific enzyme and the failure of any one in the series breaks the chain. If the enzyme activator of a reaction is destroyed by combination with an antibiotic the reaction fails to proceed and the normal chain of events is interrupted. It is probable that in sensitive microbes the critical interruption is in the chain of reaction which provides energy for other essential cellular processes. It is now well known that reactions which characterize some microbes do not occur in other microbes or tissue cells. This is the key to the toxicity of antibiotics for certain microbes and the lack of toxicity of other microbes or tissue cells.

The effectiveness of the antibiotics has sharp limitations. They are not effective with many important species of microbes. Chief of those not affected are the simplest of all microbes, the viruses. There are good theoretical reasons for doubt concerning the finding of an antibiotic which will act on the intracellular parasitic viruses. However, theories change with new facts.

There is a further serious limitation resulting from the fact that microbes initially sensitive to the antibiotic tend to mutate i the

presence of sublethal concentrations of the agent. The result is a strain of the microbe resistant to that particular antibiotic. The mutant develops a metabolic pathway different from the parent strain, a pathway which is not blocked by the antibiotic. It not infrequently happens, especially in the case of a chronic microbe infection, that the introduction of an antibiotic initially gives the patient much relief as large numbers of the microbes are inhibited but gradually, as mutation proceeds, the antibiotic resistant forms take over the field. This means not only that the initial benefits to the patient are lost but that the antibiotic resistant microbes may spread to other individuals. It may follow that present day antibiotics will lose their effectiveness as the microbe population becomes resistant. New antibiotics to which the microbes are not resistant will be required.

The reception of the antibiotics has been accorded the well-deserved glamour usually surrounding that which is new. In this case the glamour of the new has in no way detracted from the importance of former procedures or reduced the rate of further development along the older lines. The antibiotics provide an important supplementary method, not a replacement of older methods of microbe control.

At best, antibiotics and other chemotherapeutic agents provide a *post hoc* attack. After the microbe is well established in man's body and is occasioning sufficient injury to produce disease symptoms we introduce antibiotics in an effort to destroy it. The more direct approach to the problem is to prevent the entrance of the microbe or to so increase man's immunity that if microbes do enter they are unable to develop. At the beginning of this address I reviewed some familiar examples of what has been done in this connection. It should be emphasized that we are not at the end of such developments. We are still finding improved methods of preventing or retarding the spread of microbes and we are still finding means of immunizing man against more and more types of microbes.

The yellow fever microbe which formerly made many otherwise rich parts of the earth almost untenable for man and prevented many ambitious projects, such as De Lessep's attempt to build the Panama Canal, is now controllable and well under control in many regions. Fifty years ago it was shown that the principal vector of the yellow fever microbe is one particular species of mosquito. Control of this mosquito greatly reduced the spread of the disease and turned many plague spots into comfortable habitations. Much more recently, with increased knowledge of the causal microbe, a vaccine has been developed which gives man a high level of immunity over a long period. These two control measures will be improved but the efficiency of present methods

has been established in wide areas. Only economics and ignorance of what is known hold back their full application.

When Napoleon's army in Egypt was cut off by the British fleet, Turkey was invaded through Palestine as the apparent beginning of an overland return to Europe. During the siege of St. John of Arch, typhus developed in the French army with the result that although a few senior officers slipped through Sir Sidney Smith's naval blockade, the rest were lost, not to the Turkish army but to the typhus rickettsia. Later, Napoleon's grand army 400,000 strong with great acclaim advanced into Russia. They made rapid progress until they met the typhus rickettsia supported by several other microbes. Three-quarters of the army was lost by the time Moscow was reached, mostly lost to the typhus microbe. In Moscow, the microbe continued the attack until it forced the ignominious retreat. The typhus rickettsia, not the Russian army, was responsible for the military disaster. During the First World War Serbia was attacked by the Austrian army. The battles surged backward and forward until the Serbs were attacked by the typhus germ. In a few months the Serbian army was devastated and half the civilian population was dead, but the Austrians were afraid to advance, afraid of the lowly typhus microbe. The history of war is dotted with such examples.

When our troops went into North Africa in the last war typhus was endemic in the native population and when they landed in South Italy an incipient epidemic of typhus broke out in the local population. A few cases occurred among Allied troops but they were relatively mild and too few in number to have any military significance. Forty years ago it was demonstrated that the mode of transfer of the typhus microbe from person to person is via the agency of vermin-lice. Our troops in North Africa had the benefit of a new and highly effective insecticide, DDT which greatly reduced the number of vectors but they were also protected by a newly developed vaccine. This vaccine is not a perfect immunizing agent but it conspicuously increases man's resistance to this microbe.

Troops in the Far East in the last war were seriously menaced by a microbe disease, scrub typhus, which had previously been regarded as having a sharply restricted distribution and being of little importance. It was soon found that it was spread by a minute tick or mite. This was difficult to control but towards the end of the war a vaccine was developed which provided a high level immunity.

New knowledge of the poliomyelitis virus suggests that we are on the edge of a significant development in the immunization against this vexatious microbe.

Many similar examples might be cited to indicate that progress is being made in the direct control of microbes. It is much too far a cry to suggest that such direct methods will make the use of antibiotics and other chemotherapeutic agents unnecessary. It will long be possible for some microbes to penetrate the best barriers we can erect. Other microbes will long defeat all efforts to immunize against them.

The antibiotics and related compounds have given us a new weapon of enormous value and potentialities not yet fully realized but the older and more desirable means of combating man's microbes are not outmoded nor have means of expansion and improvement of these methods dried up. The next decade will see great expansion in the antibiotic field. There will be equal or greater expansion in the field of immunization.

This may lead to a dilemma if a dilemma has not already been reached: too few microbes, too many men. The human population of the world is rapidly increasing. To a large extent the reason for the increase is the partial control of microbes. Should we again give the microbes full sway, should we reduce our efforts to extend knowledge of control to the already overpopulated corners of the earth? The underprivileged half of the world is in revolt. Liberty may be the slogan but ignorance, semi-starvation, pestilence, and early death is the root. Much has been done to make our knowledge of microbe control universal, to deal with but one of the problems, and the tempo of this type of missionary work is increasing. In so doing are we contributing to the imbalance and compounding the dilemma? Babies saved from diphtheria typhoid and typhus microbes must be fed in order to produce more babies. Should we declare a holiday and give the microbes a better opportunity to balance population against resources? To the microbiologist these are futile questions. He will pay little attention to the rate of development of agriculture, economics, or politics. He will continue his researches not primarily for humanitarian reasons but for the pure joy of discovery.

APPENDIX B

BIOGRAPHICAL SKETCHES OF DECEASED MEMBERS

William Clifford Clark

1889–1952

DR. W. C. CLARK, Deputy Minister of Finance in the Government of Canada, who died suddenly December 27, 1952, was appointed to that office in 1932 and elected to Section II of the Royal Society of Canada in 1939. The demands upon one in his position made by the Second World War and the problems of the post-war years left him little time to participate in the programme and business of the Society. Yet he contributed impressively to the purposes which the Royal Society exists to promote. More than most others he was responsible for setting the new pattern of employing in the government service, in administrative as well as in technical posts, university-trained men who were experts in the social sciences and the humanities.

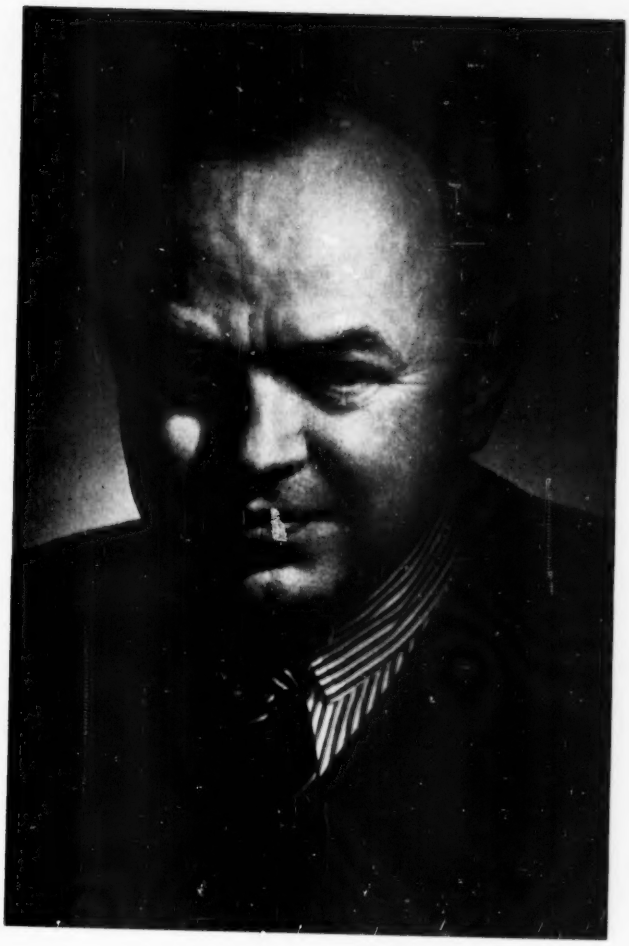
Clifford Clark was born on a farm in Glengarry County in eastern Ontario, was educated in Glengarry schools and entered Queen's university in 1906. In 1910 he was awarded the degree of M.A., having completed the honours course in Latin and French with first-class standing in both subjects. In two more years he completed the honours course in history, English, and political and economic science. This shift in interest was probably due to the influence of O. D. Skelton who so uniquely combined great scholarship with a genuine and unpatronizing interest in national politics and policies. Entering Harvard in 1912 to study economics, Clark soon became a favourite pupil of that great teacher F. W. Taussig. Setting aside the brilliant academic career in the United States which was clearly open to him, Clark returned to Queen's in 1915 to join Skelton's staff. Together he and Skelton developed the Department of Political and Economic Science and began at Queen's professional courses by correspondence for employees of the Canadian banks and for those preparing to be chartered accountants whose subsequent growth attests the soundness of the foundations on which this method of instruction was built. At the same time a new curriculum was offered in the Faculty of Arts leading to the degree of Bachelor of Commerce. In 1923 Clark left Queen's to join a large American investment house. Beginning as economic adviser in the Chicago office, he eventually, in the late 1920's, moved to New York and became a vice-president of the company. In 1931 he returned to Queen's to resume direction of the courses in Commerce he had helped to establish. Focusing his restless energy once more upon Canadian affairs he found himself within a

year an adviser of the Canadian Prime Minister, R. B. Bennett, at the Imperial Economic Conference held in Ottawa in the summer of 1932. So impressive was his performance there that Mr. Bennett made him Deputy Minister of Finance in October, 1932. That Dr. Skelton had already moved to Ottawa to become Under-Secretary of State for External Affairs did not make the prospect of this new post any the less attractive to Clark. The problems of the great depression were already revealing their appalling dimensions. Skelton and Clark were once more together to tackle them.

The economic policy record of the federal government during the 1930's shows no resting content with emergency measures. On the contrary a vigorous beginning was made on the revision of the financial relations with the provinces to put their credit on a sounder basis while giving to the federal authorities the powers over taxation essential to the new policies for the maintenance of income and employment. A central bank was set up to aid in the formulation and administration of monetary policy. Well-trained men were recruited by the Bank of Canada, the Department of Finance, and other branches of the government. They studied the domestic and external affairs of the country with unprecedented thoroughness.

When war put emergency powers into the hands of the Dominion government it was thus in a position to act promptly as, for instance, in the establishment of foreign exchange control. Foreign observers agree that the fiscal and economic problems of war were effectively handled in Ottawa. During these years our civil servants also found time to play a prominent part in the formulation of international plans for post-war trade and employment policy. They planned, and Parliament passed in 1944, a remarkable body of legislation giving the federal government more of the powers believed necessary to aid in the fight against the post-war deflation everyone expected. When inflation proved to be the real problem, however, the adaptation of policy to this unexpected development showed great ingenuity and flexibility.

W. C. Clark's role in all this it is impossible yet to disentangle; it may never be fully known. In our system the work of the good civil servant is anonymous. Throughout his life Clark carried on, with all sorts of people, a vigorous discussion of plans and projects which greatly extended his influence. As Deputy Minister of Finance he might have confined his contacts with the members of his department largely to the consideration of their written submissions. On the contrary he led a "team." Policy recommendations were hammered out in group discussions in which Clark drew out the best its members



William Clifford Clark

had to offer. This method of work certainly made a career in the government service attractive to many who otherwise might have found the limitations of subordinate position frustrating.

That out of all the discussion, administration, and law-making of the twenty years of Clark's Deputy Ministership Canada was equipped with the machinery of a modern economic policy is a remarkable achievement; that it was also accompanied by the necessary changes in the attitudes of Canadians, particularly of business men, and that these were achieved without the extremes of partisan controversy which occurred in the United States is even more remarkable. The Canadian temperament and the parliamentary form of government were important in this upshot. But the transformation was made much easier by the moderation shown by the government toward the business community during the depression; there was no extreme denunciation, no "cleansing of the temple."

For this attitude Clark had no little responsibility. His academic and business experience led him to appreciate the views of the reformer and the conservative alike. The sympathetic hearing business men got in his office softened the blow when refusal of their requests came from one whose single-minded devotion to the national interest they recognized. During the war business men were brought fully into the team-work of the government service. They left it with greater appreciation of the problems of the bureaucrat and more confidence in the quality of the civil service.

Clifford Clark put his great capacities and his thorough university training willingly to the test of practical affairs. The success he won advanced mightily the role of the trained man in Canadian public life.

F. A. KNOX

George Herbert Clarke

1873–1953

AS an able professor of English, a gifted poet, and a fine literary critic, George Herbert Clarke attained varied distinction in the course of a long and fruitful life. He was born at Gravesend, Kent, in 1873, but came to Canada as a young boy. In 1895 he received his B.A. degree from McMaster University, and two years later went to Chicago to engage in editorial work. His academic career began in 1901, and from then up to 1925 he was a professor of English literature in several American institutions, the most important of these being the University of Tennessee and the University of the South. In 1925 he returned to Canada as Head of the Department of English at Queen's University. He held this position until his retirement in 1943, when he became Professor Emeritus. He retained his post as Chairman of the Editorial Board of the *Queen's Quarterly* up to the time of his death in March, 1953.

Professor Clarke received honorary doctorates from three Canadian universities, McMaster, Bishop's, and Queen's. He was elected a Fellow of the Royal Society of Canada in 1930, and in 1939–40 was the President of Section II. In 1943 he was awarded the Lorne Pierce Medal for distinction in Canadian literature. He was also a Fellow of the Royal Society of Literature.

In view of his devotion to poetry it seems fitting in a brief tribute to his memory to stress his creative work in this sphere. He published three collections of verse in book form: *At the Shrine and Other Poems* (1914), *The Hasting Day* (1930), *Halt and Parley and Other Poems* (1934). Some of his finest writing in poetry was done after the printing of the last of these booklets. In the closing years of his life he was engaged in preparing an edition of his collected poems, and had made preliminary arrangements for their printing. As his friends realize, the publication of these was an objective very dear to him. On this account as well as for the sake of Canadian literature it is much to be hoped that the project, interrupted by his death, will be carried to completion. If the volume he had planned is printed, it will more adequately represent the scope of his poetic achievement. My conviction is that such a book will lead to a steadily growing appreciation of the distinction in quality of his poetry, and a wider recognition of its permanent worth.

Clarke's voice in poetry is an individual one, striking a note rather rare in Canadian literature. This is achieved, not through novelty of form and content, but through an attitude of mind and spirit revealed in the tone and temperament of his verse. His outlook on life is meditative and reflective. He is not an impassioned poet, and avoids themes which lend themselves to the expression of fervent emotion. Possibly, innate reserve inhibits in him the spontaneity and verve of a poet who gives free rein to the impulses of his genius. Yet this reticence has its virtues. Even when Clarke feels strongly he always preserves artistic self-control. The craftsmanship of his poetry is the fruitage of a cultured and disciplined mind. He studiously avoids rhetorical effects and prefers undertones to over-emphasis. His poetry is invariably sincere and never meretricious.

Although Clarke has given us some charmingly intimate pictures of nature, full of warmth and colour, she appeals to him most in her large and cosmic aspects. He is, perhaps, closer akin to Thomas Hardy than to any other poet. Like Hardy he has an acute perception of the immensity and mysteriousness of the elemental forces back of the universe. He, too, feels the contrast between these and the physical littleness and finitude of man. In Hardy this often evokes an ironical and indignant protest, as he pictures humanity combating an alien universe. Clarke's temperament is more tender and genial than that of the English poet. He recognizes the disparity but minimizes the antagonism between man and nature. His spirit is that of a stoic acceptance, or at times of a brooding wistfulness.

It is the poignant motif of "the burden of the mystery" of things which inspires much of Clarke's nature poetry. The sea in its vastness and loneliness, the moon shrouded in a mystic veil of fog, the continuous circling of gulls with their eerie cry: these seem symbolic of the ever-voyaging mind of man beating in vain to penetrate the inscrutable purposes of the Spirit of the universe.

Again like Hardy, he feels that the moral values of life, the courage and heroism of the indomitable soul, lift man above his outward weakness and the ephemeral character of his earthly lot. In what is perhaps the best known of Clarke's poems, *Halt and Parley*, a little miracle play in modern guise, this belief is given dramatic expression. The body pays the toll exacted by Death, but the soul passes through the gate, and its nobility is stressed:

> Man the afraid, infirm, impure!
> Yet how he can love and how endure,—
> Endure to the end and arise again,
> Victorious victim of passion and pain. . . .

George Herbert Clarke

It is much to be regretted that Clarke's *Odes* have not yet been published in a collection of his verse, since he rightly regarded them as his most important contribution to Canadian literature. The ode is the most elevated form of lyric poetry, and therefore congenial to the elements of largeness and dignity in Clarke's work. One of the finest of his poems is the "Commemoration Ode" composed for the centenary anniversary of Queen's University; and the "Ode on the Burial of King George the Fifth" is probably his masterpiece.

Dr. Clarke's work in prose was linked with his editorship of two university magazines. From 1920 to 1925, while living in the United States, he edited the *Sewanee Review*. Under his guidance, this review attained a distinctive place amongst American scholarly journals. In contrast with more strictly technical journals it fostered humanistic literary criticism of a high standard. His connection with the *Queen's Quarterly* began after his return to Canada in 1925. Articles and reviews printed in it won him repute as a Canadian critic who wrote with discrimination and authority. His sane judgment, aesthetic culture, and acumen of scholarship, admirably equipped him with the basic critical qualities of objectivity and insight.

George Herbert Clarke's personality was endearing. A sensitive man, with a good deal of quiet dignity and reserve, he was also warm-hearted and sympathetic. His lack of family ties seemed to enhance his genius for friendship. He was most loyal and devoted to his many friends, sparing no effort or sacrifice of his time and comfort to be of service to them. When on a holiday trip, his geniality and buoyancy of spirit were constantly in evidence. His keen sense of humour and inexhaustible fund of good stories lightened serious conversation, and made him the best of travelling companions. Courteous and considerate, he exemplified in his life the virtue of equanimity as Marcus Aurelius defined it: "Cheerfulness in all circumstances . . . and a just admixture in the moral character of sweetness and dignity."

Dr. Clarke was a staunch supporter of the ideals of the British Commonwealth of Nations. In one instance, his decision to retain his British citizenship in the United States involved the sacrifice of an important professorial position he was then holding. He has compiled and edited three fine *Treasuries of War Poetry*, and the noblest of his odes is that written on the burial of King George V.

Several of Clarke's poems are elegaic in mood. It was not, however, to his stately and solemn requiem on the funeral of a British sovereign that one's thoughts turned at the time of his own burial. It was rather to a tender and poignant little poem which he wrote in 1949

on the death of his old friend, Professor Alexander ("Sandy") Macphail. The burial lots of the two men are next each other in a peaceful country cemetery.

I

This is the place, you said;
Do you like it? The summer sun
Warmed us; grass and trees
Green-glowed; the mellow bees,
Droning their low burdoun,
Drifted among the dead. . .
The well of silence filled,
The day stilled.

II

Now in winter cold
As you turn to that place,
Tired of being old,
And folk of your stoic race
Follow for the end,
Again I seem to hear
The voice of my friend:
Do you like it?—Ah, Sandy dear,
Who knew to live, and die,
How shall I reply?

W. O. RAYMOND

Henry Franklin Dawes

1881–1953

HENRY FRANKLIN DAWES, M.A., Ph.D., F.R.S.C. (retired), Emeritus Professor of Physics, McMaster University, died at his home in Hamilton, Ontario, after several months of rapidly failing health. Born in Paisley, Ontario, he obtained his early education in Woodstock and entered the University of Toronto with scholarships in Mathematics and Physics and in Classics. After graduation in 1904 with a Bachelor's degree in honour Mathematics and Physics and the London Gold Medal in Physics, he stayed at Toronto as demonstrator in Physics, obtained an M.A. degree, and was awarded the Wollaston Research Scholarship of Caius College, Cambridge University, in a British Empire competition. From 1906 to 1908 he studied at the Cavendish Laboratory, carrying out research on ionization by collision in helium and argon, under the direction of Sir J. J. Thomson. He returned to Toronto and held the position of lecturer in Physics until 1911 when he joined the faculty of McMaster University. He was Head of the Department of Physics in that university until retirement in 1948.

During World War I Professor Dawes carried on instructing duties and research in the field of optics. He also assisted Professor J. C. McLennan in investigating, for the British Admiralty, sources and methods of extraction of helium in Canada. He obtained a Ph.D. degree from the University of Toronto in 1918, was elected a Fellow of the Royal Society of Canada in 1922, and was a Fellow of the American Association for the Advancement of Science and a member of the Royal Canadian Institute and of the American Physical Society. In World War II, in addition to the duties of Head of his Department, he organized and directed the training of four classes of R.C.A.F. radio technicians. In this, and in the task of extending Physics laboratory courses to meet the demands arising from rapid wartime and post-war developments in electronic and nuclear physics, his special talent for designing workable, instructive, and often inexpensive apparatus, was invaluable. After retirement in 1948 he continued to assist the Department voluntarily in many ways and in particular by building, mostly with war surplus material, apparatus for the study of microwave electronics, which is now being used in research.

Dr. Dawes was highly respected by all for his honest and forthright manner, and by his colleagues and students for his friendly interest

in their welfare and his untiring attention to maintenance and improvement of courses in Physics. He was loved by those whose good fortune it was to come to know him well. He served to the utmost his family, McMaster University, and his country, until increasing physical weakness forced permanent confinement, which he endured for months with remarkable fortitude and cheerfulness.

A. B. McLAY

HENRY FRANKLIN DAWES

John Murray Gibbon

1875–1952

JOHN MURRAY GIBBON was born at Udeweller, Ceylon, on April 12, 1875. He came of good stock: Archbishop Cranmer was one of his ancestors and his father was Sir William Duff Gibbon, originally of Aberdeen, Scotland, one of the pioneer tea planters in Ceylon, who was knighted for his services on the Legislative Council there.

His early education was in the same tradition. After training at Gordon's College, Aberdeen, and King's College, Aberdeen, where he was first in the English class taught by the then celebrated Professor Minto, he entered Christ Church College, Oxford, as an Exhibitioner and graduated with first-class honours in "Literae Humaniores." Apparently destined to become a distinguished scholar, he then proceeded to the University of Göttingen, in Germany, where he specialized in Sanskrit and Greek archaeology.

A restless craving for other fields manifested itself, however, and the keen academic scalpel was ultimately used to peel journalistic potatoes and literary apples. In one considerable interval he even studied art in the Westminster School, London, and in the Colarossi Atelier, Paris, and bade fair to become a painter of note, but the increasingly dominant interest was journalism in the grand manner. He served his apprenticeship for a year without pay on the staff of *Black and White*, succeeded Eden Philpotts as assistant editor and eventually became editor-in-chief.

The year 1907 marked his first contact with Canadian life. Apparently attracted by Gibbon's contributions to the *Illustrated London News*, Lord Shaughnessy of the Canadian Pacific Railway asked him to supervise that firm's European propaganda, a task which took him on extended visits to Russia, Japan, Austria, Hungary, and Scandinavia. In 1913, he was brought to Canada as General Publicity Agent for the C.P.R. and this was to be his life work until his retirement in 1945 at the age of 70. With him came his wife, Anne, daughter of Henry Fox, J.P., of St. Bees, Cumberland, whom he had married in 1900, and their three sons (Murray, John, and Philip) and one daughter (now Mrs. A. F. Shepard, of Guildford, Surrey, England).

To what might have been a very pedestrian sort of job, Murray Gibbon brought unusual qualities of imagination and unusual insight into the complex character of the Canadian people. Hence it was,

for instance, that he sensed the value of French-Canadian folksongs not only in themselves but as a means of interpreting French Canada sympathetically to a predominantly Anglo-Saxon continent. He became a pioneer in translating these into singable English versions and began a notable vogue for them by having the Canadian Pacific Railway stage three extensive folksong and handicraft festivals in Quebec City.

The same interest in folksong and handicrafts then led him on to stage great festivals in Winnipeg, Regina, and Calgary, featuring the music and folk arts of the great European-Canadian communities of Western Canada, chiefly Slavic, Germanic, and Scandinavian in origin. An ultimate by-product of this enthusiasm was his most important book, *The Canadian Mosaic* (1938), in which he assesses the value to a Canadian culture of the numerous traditions brought to this land by nearly a score of important nationalities.

He had long since singled out one of the earlier stocks for special treatment in his book, *Scots in Canada* (1911), and from this there followed naturally three Highland Gatherings at Banff, each with elaborate concerts of Scottish music. With the same shrewd mixture of genuine culture and underlying transportation necessities, he also organized sea music festivals at Vancouver and Victoria. Of even more vital permanent effect was his founding in 1924 of an organization known as the "Trail Riders of the Canadian Rockies" and in 1933 of the "Sky Line Trail Hikers of the Canadian Rockies," groups that are still exceedingly active today.

Related closely to his interest in French and New Canadian folk music were his close study of the history of music and his volume *Melody and the Lyric* (1920), in which he analysed the tunes used in connection with English lyric poetry over a period of three hundred years. This pioneer study in its field was awarded a David Prize by the Province of Quebec, and its author in the same year was given an honorary doctorate in letters by the University of Montreal.

During the period 1917–26, Murray Gibbon published five novels: *Hearts and Faces* (1917), *Drums Afar* (1919), *The Conquering Hero* (1921), *Pagan Love* (1926), and *Eyes of a Gypsy* (1926). They showed competent craftsmanship but were not great literature. That they were the systematic product of hard work on weekends over a decade or so appears from the recorded comment of one of his small sons: "I don't like Sunday. That's the day that Daddy writes his novels."

A fellow feeling for other Canadian authors in the iniquitous copyright situation in Canada following World War I, in which federal legislation was pushed through permitting Canadian printers to print

JOHN MURRAY GIBBON

any book by any writer even without his permission, led Gibbon to found the Canadian Authors' Association in 1921 for the express purpose of obtaining justice. He became the first national president and for many years (before the Board of Transport Commissioners vetoed the arrangement) supplied most Canadian authors with free C.P.R. transportation to the annual convention.

Unquenchable enthusiasm and methodical toil permitted Gibbon to publish some two dozen books, ranging from a volume of fairy tales (*In the Reign of King Cole*, 1900) to a history of Canadian nursing (*Three Centuries of Canadian Nursing*, 1947).

He was elected a Fellow of Section II of the Royal Society of Canada in 1922 and was the fourth senior active member of the Section at the time of his death. In 1939 he was awarded the Lorne Pierce Gold Medal of the Society, "propter operam summam ad litteras patrias augendas."

John Murray Gibbon was one of the most laconic and retiring of men, but his air of gentle abstraction concealed business acumen, relentless energy, and imaginative scholarship which had turned the tasks of propaganda into genuine projects for the enrichment of the cultural life of his adopted country. No man in the twentieth century has done more for the spiritual integration of the Canadian people.

His end reflects some of the manifold influences of his life. Mrs. Gibbon writes me thus: "My husband's Ashes were buried in Banff Cemetery, in the presence of a large number of the Trail Riders and Hikers of the Canadian Rockies. Our old friend, Dan McCowan, the Naturalist, gave an address, and two Stoney Indians, who had often acted as John's guides and of whose tribe he had been made a chief, attended in ceremonial dress. A piper played the lament 'Flowers of the Forest.' A bronze plaque is to be placed on his resting-place 'among the mountains that he loved.' "

WATSON KIRKCONNELL

Francis Charles Harrison

1871–1952

FRANCIS CHARLES HARRISON was born in Gibraltar on February 19, 1871, the son of an army officer. He attended public school in England before coming to Canada in his late teens to study at the Ontario Agricultural College, where he obtained his B.S.A. in 1892. He subsequently undertook graduate work at the universities of Cornell, Wisconsin, Berne, and Copenhagen, returning to the Ontario Agricultural College in 1894 as assistant in biology. In 1896 he was appointed the first Professor of Bacteriology at the College, a position which he held until 1905 when he transferred to the corresponding chair at Macdonald College, McGill University. During his first two years there he read for and obtained the degrees of M.Sc. and D.Sc. Three years later, in 1910, he received the additional appointments of Principal of the College and Dean of the Faculty of Agriculture. He held these three positions concurrently until 1926 when he became Professor of Bacteriology in the Faculty of Medicine at McGill. In the following year he was appointed Dean of the Faculty of Graduate Studies and Research; he held both appointments until his retirement in 1930, on account of poor health, with the rank of Professor Emeritus. He left Canada then to settle in Florence, Italy, where he remained until, on the outbreak of war he returned to England. Until his death at the age of 81 on August 27, 1952, he lived in Westmoors, Dorset.

In 1910, he was elected a Fellow of the Royal Society of Canada and had the distinction not only of serving as the first President of Section V in 1918–19, but of being elected on a second occasion in 1923–4.

During the whole of his long and active life, he had a strong interest in public health and his many scientific contributions on agricultural, dairy, food, and fish bacteriology, reflect this interest. He was for many years a member of the American Public Health Association and the American Society of Bacteriologists, becoming president of the latter in 1921–2.

In addition to his academic duties, Dr. Harrison took a great interest in the defence of the Dominion. For many years he was an officer in the Canadian Militia, and from 1907 to 1911 he commanded the Third Field Battery in Montreal. He then served as a reserve officer until 1914, when he organized and commanded the Macdonald

College Contingent C.O.T.C. He was later promoted to the rank of Lieutenant-Colonel and served as Assistant Adjutant-General at the Petawawa Artillery camp. At the conclusion of World War I, he went overseas in the Premier's party and was placed in charge of the Agricultural Section of the Khaki University.

Dr. Harrison was in many ways a remarkable man, possessed of great energy and industry and with no mean artistic ability. In spite of his pressing duties as Principal of Macdonald College, he continued his teaching and research. Yet he found time to do a considerable amount of painting. The frieze of the dining room of his residence was painted with many scenes from Shakespeare's plays, and other parts of Harrison House, as it is still called, bore evidence of his skilful brush. Despite his manifest abilities and the multiplicity of his skills, he was surprisingly shy, and this shyness, coupled with an imposing presence and occasional brusqueness of manner, militated against his having many close friends. Nevertheless, he had great charm of manner and his intimates and the friends who broke through this wall of shyness remember him with affection.

He is survived by his widow, the former Margaret Rosalind Mills of Guelph, Ontario, by three daughters, Mrs. William V. Crossen, Mrs. Melville P. Merritt, and Mrs. W. Morrow Roosevelt, and by two sisters and a brother in England.

E. Melville DuPorte
Thomas W. M. Cameron

FRANCIS CHARLES HARRISON

Harold Adams Innis

1894–1952

ON November 8, 1952, there died at his home in Toronto, after a long and painful illness, one of the ex-Presidents of this Society, Harold Adams Innis. Coming to the Presidency of a society of old men at the age of 52, Innis in 1946 was almost a youth. Yet he had already had a career into which had been packed far more than falls to the lot of the average scholar. His remaining six years were to widen and deepen his experience. At 58 he had, it may perhaps be said, lived a long life. Every academic honour had already come to him — important rank in his own institution, honorary degrees, the presiding office in the professional societies with which he was identified, including the Royal Society. Government had frequently demanded his services. As a scholar his performance had been attested by a steadily lengthening row of books and by an almost careless proliferation of articles. More important than these elements of a conventionally successful career, was the position which he had won in the lives and hearts of his colleagues everywhere throughout this country and far beyond its borders. No one had exerted stronger influence in the growth and direction of Canadian social studies, nobody's advice was more frequently sought, no man had attached more friends more deeply to him.

This is not the place for an outline and appraisal of his career, nor would space permit a mere enumeration of his publications, even were that here appropriate. In these sad acknowledgments of mortality which Fellows of this Society must write each year, and some of us with increasing frequency, we do best to pay simple tribute to friendship. The writer wishes here publicly to pay that tribute, to a friendship, intimate and close, of thirty years. He thinks, of course, of Innis the scholar, Innis the academic leader, Innis the courageous defender of the individual against the all-devouring collectivity; he thinks still more of Innis the good companion, of the Innis who ran a fish-hook in his fingers out in the bush, or struggled dangerously yet manfully with a punting pole at Oxford, of the Innis of innumerable fireside discussions, the man whose house was always open to his friends, the Innis of mordant wit and gay repartee, or profundity veiled in easy chaff.

Harold Innis was an example of a familiar species, one that with the growing wealth and complexity of our society, its rapid removal

of itself from its formative days, will probably become less frequent—the country boy who struggles upward to the top. By family tradition, he belonged to that indomitable band of individualists who seem to focus in the Baptist Church. In his own person and from his own experience, he was faced with all the problems of our evolving society. On many of them he set a deep mark, and if something of primitive virtue is to be saved for us, he and the men he influenced will have been instrumental in that salvation. Against other tendencies of our modern world, he fought—with what success who shall say? No one can estimate the total impact and ultimate ramifications of a life, more especially of a great life. Everyone who knew him would agree that few lives have carried further than Innis's.

A. R. M. LOWER

HAROLD ADAMS INNIS

Douglas McIntosh

1875–1952

IN the death of Douglas McIntosh, Canada lost a man who has made a most outstanding contribution to the development of Chemistry in Canada. Born in New Glasgow, N.S., in 1875, McIntosh was the son of Robert McIntosh, captain of his own sailing ship, the *Helga*. The taste for exploration and adventure that sent the father over the Seven Seas prompted the son to explore the realms of knowledge. McIntosh attended school in New Glasgow and afterwards Pictou Academy, that famous school where so many outstanding Canadians received their education. After receiving his B.Sc. degree at Dalhousie University in 1896, McIntosh was nominated for an 1851 Exhibition Scholarship, and proceeded with his studies at Cornell and then Leipzig. He became a demonstrator at McGill University in 1901; lecturer in 1904; earned a Doctor of Seience degree from McGill the following year; became an Assistant Professor, Associate Professor, and finally a full Professor in 1914. Elected to the Royal Society of Canada in 1909, he became President of Section III in 1926.

During these years at McGill, McIntosh was showing his happy faculty for teaching. With his Scotsman's love for learning, he inspired his students with his own curiosity, and it was directly due to his influence that many young men went into the field of chemistry. Lord Rutherford was at McGill during these years, and McIntosh participated to a considerable extent in the radioactive investigations—then in their infancy. Rutherford's appreciation of McIntosh appears in some of his published letters.

In 1915, McIntosh accepted the chairmanship of the Department of Chemistry at the young University of British Columbia. While there, he made his contact with chemical industry in Canada, acting as a consultant research chemist for Consolidated Smelters in British Columbia and Canadian Electro Products Company of Shawinigan Falls, Quebec. In 1918, he acted as consultant chemist with the United States Government Research Bureau, Gas Division, and later on as research chemist at Tate Electrolytic Textile Processes at Cranston, U.S.A.

In 1922, McIntosh returned to his own Dalhousie University to become Research Professor in the Chemistry Department there, and in 1926 became the Head of the Department. In 1931, he was offered

the position of Research Director of Shawinigan Chemical Ltd. in Shawinigan Falls. This meant a break with his university life, and it was not without much thought that he finally accepted the position in Shawinigan. There, as everywhere else, apart from his own accomplishments, people were influenced by McIntosh. His ideal was to make industry cognizant of the value of research and, by his own example, he did much to accomplish this. He stayed in Shawinigan, living at the Cascade Inn until his death in 1952.

The first of the many papers published by McIntosh appeared in 1896 on the "Calculation of the Conductivity of Mixtures of Electrolytes having a Common Ion." This was followed by a variety of papers on solubility products, electrolytic potentials, molecular conductivity, and inorganic ferments.

It was at the beginning of this century that he became interested in the basic properties of oxygen; this was to prove one of his main interests, and to this field he made published contributions for over thirty years. He found out that organic compounds containing oxygen dissolved in the halogen hydrides forming conducting solutions. McIntosh showed that liquid halogen hydrides are without solvent action on inorganic compounds whereas ethers, alcohols, ketones, and other carbon compounds containing oxygen yield conducting solutions which show a sharp distinction from aqueous solutions. With the former, molecular conductivity decreases markedly with dilution. McIntosh pointed out that the organic solvent cannot be regarded as the solvent and the hydrogen hydride as the solute. Complex salts are formed and they yield ions with inclusion of the organic substance. Compounds of the organic substances with the hydrogen halides were isolated. While inorganic compounds with water or alcohol of crystallization form many combinations containing a large number of oxygen atoms, one molecule of organic compound unites only with one or two of the hydrogen halides. The melting point of the halogen hydride–organic compound is far above the melting point of the constituents. It was considered by McIntosh that the union is brought about by the increase in valency of oxygen at the low temperatures employed. The combination with the halogen hydrides is accompanied by evolution of heat which measurement showed to be equal to or greater than when a halogen acid is neutralized by KOH. Called oxonium compounds, they conduct the electric current whether molten or in solution of either constituent. Chlorine and bromine compounds were also discovered but these form with little evolution of heat and are non-conductors.

Douglas McIntosh

In collaboration with the late Dr. A. S. Eve, McIntosh examined the radioactivity of igneous rocks found in the neighbourhood of Montreal and borings from Beachville, Ont., from a depth of approximately 3,000 feet. In every case the specimens examined contanedi much more radium than that required for the existing temperature gradient of the earth. The amount of radium emanation existing in the water and gases of the Caledonia Springs near Ottawa was also examined.

McIntosh was a most ingenious inventor of experimental devices. He prepared a thallium mercury liquid alloy thermometer which would read down to $-70°$ C. Among other gadgets may be mentioned a CO_2 generator, an apparatus for the purification of nitrogen, an acetylene generator, an automatic siphon, and a rubber bulb attachable under the scale pans of a chemical balance to prevent oscillations.

He investigated the reaction of dried substances at low temperatures; colloidal solid solutions; the electrolytic precipitation of zinc. While the above gives a brief résumé of some of his published work, McIntosh inspired innumerable other investigations, generously declining to have his name attached as joint author when the time came for publication.

Douglas McIntosh had a flair for friendship. Wherever he went, he made friends—not friends of an hour or two, but friends who were devoted to him to the end of his life. He was an ageless sort of man whose lively interest made him as lovable to the young as to his contemporaries. He was a delightful conversationalist loving a good argument, and quite capable of politely disagreeing with some one to get an argument going. He enjoyed his game of bridge which he played with a Scotsman's caution. His books were an unfailing resource for he was a voracious reader. Many of the students he inspired have maintained his inspiration, and have in turn passed it on to others; now there are many men in Canada and in the United States who directly or indirectly owe a great deal to McIntosh.

A man of extreme modesty, McIntosh refused many honours, including an honorary degree offered to him by Dalhousie University, his own Alma Mater for which he had a great affection. It took great pressure on the part of his friends to persuade him to accept the C.I.C. Medal in 1950 and, although on that occasion he complained to a friend that "he was a most miserable man" to be the centre of the evening, he must have been gratified by the affection and admiration surrounding him.

Douglas McIntosh was blessed with a happy home circle, but this was tragically interrupted in 1930 when his wife, the former Bella Marcusa, died suddenly. He had two children, Kitty, Mrs. Richard Hirsch, and Robert who followed his footsteps into chemistry and is now on the staff at the University of Toronto. Devoted to his children and grandchildren, the last years of his life were made happy by the affection they showed to him.

OTTO MAASS

Alexandre Vachon

1885–1953

ALEXANDRE VACHON naquit le 16 août 1885, à Saint-Raymond de Portneuf dans la Province de Québec, et il était le plus jeune d'une famille de treize enfants. Sa mère, d'origine anglo-saxonne (Mary Davidson), se convertit au catholicisme à l'occasion de son mariage. Il entra au Petit Séminaire de Québec en septembre 1897 à l'âge de douze ans et parcourut les neuf années du cours classique, avec de remarquables succès et avec une préférence pour les sciences; il obtint le baccalauréat ès Arts en 1906. Ses principaux maîtres furent Camille Roy en Belles-Lettres, Clovis Kemner-Laflamme en Sciences, Olivier Mathieu et Alfred Lortie en Philosophie et Théologie. Il obtint la licence ou maîtrise en Philosophie en 1909 et il fut maître ès Arts en 1919.

Il fut de bonne heure destiné à l'enseignement des sciences, d'abord celui de la chimie, puis celui des sciences naturelles, et c'est à l'Université Harvard (en 1911) qu'il se prépara à cette carrière où il sut briller. L'Université Laval le désigna tôt et souvent comme son représentant à divers congrès scientifiques et il gagna facilement une réputation de caractère international. Il devint directeur de l'Ecole de Chimie en 1926, et cette Ecole, peu à peu transformée, devint en 1939 la Faculté des Sciences dont il fut le premier doyen. C'est lui aussi qui fut le premier directeur de la Station Biologique des Trois-Pistoles ouverte en 1931, avec le concours de l'état fédéral.

Ses études, ses cours, ses conférences, ses mémoires aux congrès, le rangèrent parmi les animateurs du progrès des sciences au Canada. Des universités reconnurent ses mérites en lui conférant des doctorats honorifiques : l'Université de Montréal en 1935; l'Université McGill et l'Université Queen's en 1939; l'Université Laval en 1940.

La Société Royale du Canada crut s'honorer elle-même en l'appelant au poste très distingué de membre à titre spécial en 1934.

L'Université Laval le choisit comme recteur en mars 1939. Il y aurait eu une brillante carrière et sans doute il aurait rendu à cette institution les plus grands services, s'il y fût resté assez longtemps, mais il ne fut recteur que dix mois, car le Vatican le désigna en décembre 1939 comme archevêque coadjuteur du diocèse d'Ottawa. Le titulaire, Mgr Guillaume Forbes, mourait peu après et Mgr Vachon le remplaça en 1940.

La famille et le Séminaire ont formé en Alexandre Vachon un homme

de belle trempe et de belle venue. Il aima le travail, et ceux de son entourage immédiat témoignent qu'il fut acharné au labeur dans tous les champs où il exerça son activité; il y mettait le meilleur de son énergie. Il fut bon et affable, charitable jusqu'à la générosité. Il fut loyal à ses amis, voire aux simples connaissances que la vie mit sur sa route; il n'a trahi personne et il a toujours fait honneur à sa parole. Il avait de l'entregent et une grande facilité à entrer en communication avec les autres. Avec l'enfance et la jeunesse il savait être père autant qu'ami et directeur. Il se montra toujours prêt à collaborer aux bonnes entreprises. Son esprit était ouvert à de larges horizons; il fut un grand voyageur et il y a lieu de croire qu'il a vu tous les continents. Il voyait tout avec l'œil d'un homme de science et d'un artiste. De bonne heure il sut orner sa chambre d'objets d'art, peintures, tapisseries, bronzes, bibelots choisis. Sa chapelle privée, à l'archevêché d'Ottawa, demeure la preuve de ses goûts artistiques; trois verrières, des bois en relief, l'autel, les ornements et accessoires du culte, les bancs, tout y est de bon goût. Et il fut bon; il resta très attaché à ses nombreux frères et sœurs dispersés en Canada, aux Etats-Unis (est et ouest), en Alaska; il avait un tendre culte pour sa mère. Il avait le cœur tendre et il se montra constamment un père pour ses étudiants, ses collaborateurs, ses ouailles; rien ne lui plaisait davantage que d'être parmi les enfants et à cet égard ses tournées de confirmation étaient pour lui un enchantement.

Homme de beau caractère, il fut aussi homme de science. Ce n'est pas qu'il ait inventé quoi que ce soit en ce domaine, mais il se montra animateur résolu, enthousiaste et patient. Au cours classique il eut plus de succès en sciences qu'en lettres; la rigueur des raisonnements philosophiques l'attira davantage que les spéculations théologiques. Il fut un admirateur de Clovis Laflamme, et il lui fallut de grandes aptitudes pour en devenir le disciple et le successeur, au cours de sciences naturelles. La chimie et les sciences naturelles alors, étaient considérées comme de « petites sciences ». Demers, Casault et Brunet ont dû souvent bouillir d'indignation dans leur tombe en entendant ce qualificatif. Vachon résolut, dès l'abord, de relever ces parias dans l'opinion des éducateurs dans les collèges classiques. Il devait rencontrer une étonnante résistance, car toute augmentation des heures de cours en chimie et en sciences naturelles se ferait au détriment de la philosophie. Dans les congrès d'enseignement secondaire il prêcha pour sa paroisse, mais deux paroisses voisines, philosophie et lettres, se liguaient contre les prétentions des « petites sciences ». Mais une patience résolue, un enthousiasme sincère, une politesse aussi fine que calculée devaient enfin l'emporter. Des conférences répétées sur

Alexandre Vachon

des sujets scientifiques mirent vite en vedette le jeune professeur. Sa présence aux congrès nationaux et internationaux en sciences le fit connaître, apprécier et aimer. En 1932 il entra au Conseil national des Recherches et il fut nommé directeur de la revue *Le Naturaliste canadien* la même année; membre du conseil de l'Université Laval en 1935, membre du bureau de direction de Radio-Canada en 1936; l'année suivante, 1937, doyen de la Faculté des Arts, membre de l'Office des Pêcheries, doyen de la Faculté des Sciences, et en 1939 membre du Comité Canadien d'Océanographie et vicaire-général de Québec en 1939.

L'universitaire en l'abbé Vachon ne fut inférieur ni à l'homme, ni à l'homme de science. Qu'on examine en lui le professeur, le directeur d'étudiants, le doyen des Arts, le directeur de l'Ecole de Chimie et le doyen de la Faculté des Sciences, le délégué aux congrès scientifiques et aux réunions des universités, le conférencier, le recteur qu'il fut, et partout on retrouve les belles qualités humaines, le même esprit d'organisation, la même conduite aimable et paternelle qu'on pouvait par ailleurs admirer en lui.

Ce serait cependant le diminuer que de ne pas montrer en lui son mérite par excellence, celui d'avoir été un homme de Dieu. Sa foi était profonde, sincère, tendre, active et apostolique. Directeur spirituel des écoliers, aumônier des étudiants, professeur, il ne cacha jamais son caractère sacerdotal; au contraire il le laissait voir dans tous ses actes; ses aumônes et charités ne se comptent pas. Ces vertus devaient briller davantage encore, lorsqu'il eut reçu la consécration épiscopale, comme on peut le constater à la lecture des six volumes de ses Mandements, avis et recommandations, qui touchent à une infinité de sujets variés. On y voit d'abord ses deux grandes dévotions : l'Eucharistie et la Vierge Marie, puis combien l'évêque a continué en lui l'homme de science et le prêtre. Parmi tous les centenaires qu'il signale à l'attention de son clergé et de ses diocésains il donne une place de choix à celui de saint Albert le Grand, homme de science. Le prêtre se manifeste dans les préoccupations sociales qui marquent son épiscopat. En effet, il s'occupe de la famille, des ouvriers, des patrons, des œuvres d'action catholique et sociale, des agriculteurs et des fermières, de la colonisation, de la jeunesse, de la tempérance, de la bonne presse, de la moralité du peuple. Son clergé est sa portion choisie et il lui adresse maints avis sur la liturgie, la prédication, la vie spirituelle alimentée par les retraites annuelles et les récollections mensuelles; les vocations sacerdotales, la discipline. Il avait conçu une haute ambition, celle d'avoir un bel édifice pour son séminaire; l'édifice fut construit et il est l'un des plus beaux de la capitale fédérale; mais l'expérience ne s'accorda pas

avec les prévisions, et il fallut renoncer à utiliser une maison dont l'entretien ordinaire dépassait les ressources possibles; il en exprime son regret : « Dieu en a jugé autrement: j'accepte et je Lui offre très généreusement cette épreuve et la douleur qui en résulte. »

Les missions sont l'une de ses œuvres choisies, et il n'oublie jamais qu'il fut d'abord un éducateur.

Homme de Dieu aux préoccupations élevées il ne perd pas contact avec les réalités de la terre; il prend part active à la vie civile et nationale. La grande guerre qui sévit inspire à l'archevêque d'Ottawa des cris de pitié pour les soldats, les prisonniers, les réfugiés, et de sages avis à son peuple, et une étroite collaboration avec l'autorité civile; à l'idée de guerre il mêle constamment celle de la paix et il multiplie ses appels pour la paix, une paix juste et humaine. Il s'occupe des Semaines de santé, des feux de forêts, des impôts, des emprunts nationaux, des banques de sang, de citoyenneté; il demande des prières pour le succès de la Conférence mondiale de San Francisco.

La majorité de ses diocésains est d'origine française, et il ne l'oublie pas. Rappelons ses paroles : « Cette mère,..., malgré ses origines anglo-saxonnes, m'a fait aimer d'un profond amour la race (française) de son époux bien-aimé. » Il soutient les œuvres canadiennes-françaises: Association d'éducation, Société nationale, fondateurs (français) de l'Eglise canadienne, la radio française de l'Ouest, la colonisation et les anniversaires, cinquantenaires ou centenaires des Jésuites, des Oblats, des Sulpiciens, des Sœurs grises, du diocèse, de la ville de Hull, de la cathédrale, de ses prédécesseurs sur le siège épiscopal d'Ottawa.

C'était pour lui affaire de loyauté; on peut se demander si cette vertu de loyauté ne serait pas le principe d'unité de toute sa vie, de tous ses actes. La vie d'Ottawa, si pleine déjà, aurait pu lui faire oublier le centre, beaucoup plus modeste, qu'est Québec; mais il n'en fut rien. Mgr l'archevêque aimait revenir dans la ville de ses jeunes années et dans la maison où il avait fait ses premières armes. Il ne devait pas l'oublier; lorsqu'il écrivit ses dernières volontés, le 31 octobre 1951, il traça ces lignes : « Je remercie Dieu de m'avoir conduit par mes parents à cette sainte maison du Séminaire de Québec, où j'ai vécu quarante-deux ans comme élève du Petit, puis du Grand Séminaire, et ensuite comme prêtre. J'embrasse dans un même sentiment d'affection et de reconnaissance le Séminaire de Québec et l'Université Laval, ainsi que les œuvres diverses auxquelles j'ai consacré trente ans de ma vie sacerdotale. Grâce à ces deux institutions et à cause d'elles j'ai dû étendre mes activités sur des champs variés et vastes; elles n'avaient pour but que la gloire de Dieu, l'honneur de mon Alma

Mater et le bien de mes compatriotes. C'est dans ces deux maisons surtout, c'est en travaillant à leurs œuvres que j'ai connu des êtres chers, lesquels. . . ont été pour moi des sources de joie. . . Je les remercie vivement du bonheur qu'ils m'ont apporté. »

« Je ne veux pas d'oraison funèbre », dit-il. En avait-il besoin ? *Laus ejus in ore hominum.*

La Société Royale du Canada perd en lui un membre distingué, un ami très loyal et un appui très solide.

Abbé Arthur Maheux

APPENDIX C

TITLES AND ABSTRACTS OF PAPERS PRESENTED AT THE ANNUAL MEETING

PROGRAMME OF PAPERS

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SECTION I. LITTÉRATURE FRANÇAISE, HISTOIRE, ETC.

1. Le grain de sable. La coupe inattendue. Défense de la sylviculture et compagnie. Par Adrien Plouffe, M.S.R.C.

Trois contes ad usum des grands enfants.

2. Cadieux et sa complainte. Par Louvigny de Montigny. Présenté par Adrien Plouffe, M.S.R.C.

L'auteur s'est livré à des recherches qui s'étagent sur une quarantaine d'années, afin de découvrir tout ce qui est intéressant à connaître sur Cadieux et sa complainte. Le petit rocher de la haute montagne va-t-il nous livrer tous ses secrets ?

3. Le retour de Candide. Par Adrien Plouffe, M.S.R.C.

Candide, revenant de l'au-delà, continue de cultiver son petit jardin. Après un tour du monde en quatre-vingts semaines, voyage au cours duquel il interroge les hommes d'État et les hommes du peuple, dans tous les pays, Candide nous indique comment l'homme du XXe siècle devrait cultiver son petit jardin.

4. Le rôle économique, social et culturel de l'Artisanat. Par Jean-Marie Gauvreau, M.S.R.C., et Paul Riou.

Les auteurs, après avoir étudié soigneusement la véritable définition que l'on doit donner à l'Artisanat, s'attachent à préciser le triple aspect sous lequel il faut le considérer.

5. Les mythes grecs dans la tragédie française contemporaine. Par Maurice Lebel, M.S.R.C.

Origines du retour de la tragédie française (1900-50) au mythe antique. De Suarès à Anouilh. Popularité de certains mythes dans l'œuvre des écrivains suivants: Suarès, Gide, Claudel, Giraudoux, Cocteau, Thierry, Maulnier, Merle, Montherlant, Anouilh. Adaption de ces mythes au goût contemporain. Réaction du public.

6. Luderitz: ville inconnue. Par Mgr Olivier Maurault, M.S.R.C.

Au hasard d'une lecture, l'Auteur apprend l'existence d'une ville *fantastique*, sur la côte sud-ouest de l'Afrique. *Il s'agit de Luderitz.* — Quels sont les caractères géographiques de cette côte de l'Afrique ? Quand et comment fut fondée la ville de Luderitz ? Qu'est-elle devenue ? Telles sont les questions auxquelles l'Auteur s'est efforcé de répondre.

7. Le musée de Montréal. Par Victor Morin, M.S.R.C.

Peut-on croire que la métropole du Canada, avec une population d'un million et demi d'habitants, n'ait pas encore de musée éducatif à l'usage de ses 200,000 enfants d'âge scolaire ? Le présent article préconise la réalisation d'un projet qui pourrait répondre à ce besoin.

Section I

8. Bibliographie et iconographie de Louis-Joseph Papineau. Par Antoine Roy, M.S.R.C.

Quelques mots sur la vie et l'influence de Louis-Joseph Papineau.

La Bibliographie de ce qu'a écrit Papineau. Manuscrits et imprimés.

Ce qu'on a écrit sur Papineau. Nomenclature des articles, livres, brochures et articles divers. Avec une courte analyse.

Peintures, gravures, photos représentant le grand tribun. Où elles se trouvent, ce qu'elles valent, etc. etc.

9. Grand Corbeau mate Vent du Sud. Par Claude Melançon, M.S.R.C.

Parce que Vent du Sud lui rabat la fumée de son feu dans les yeux Grand Corbeau décide de lui faire la guerre. Il lui envoie d'abord les oiseaux qui sont arrêtés en route par Vent du Sud et ses deux fils, puis les mammifères qui sont également empêchés de rejoindre Vent du Sud. Finalement Grand Corbeau et quelques poissons réussissent à s'emparer de leur ennemi et lui imposent de souffler du beau temps au moins quatre à cinq jours de suite.

10. Les origines de la colonisation par les Français dans l'Ouest, canadien. Par Donatien Frémont, M.S.R.C.

Des économistes français éminents — Onésime Reclus, Edme Rameau de Saint-Père, Gustave de Molinari — avaient pressenti de bonne heure l'avenir agricole de l'Ouest canadien et compris l'importance d'y diriger des colons de langue française. Dès 1880, un délégué de la Normandie, après une enquête sur place, recommanda fortement l'envoi de compatriotes. Hector Fabre, premier commissaire du Canada en France, fut le grand animateur du mouvement, qui eut surtout l'appui des milieux catholiques et intellectuels. La nouvelle génération de l'ancienne noblesse française fournit d'abord de nombreuses recrues; mais, sauf de très rares exceptions, elle ne réussit pas à s'implanter dans l'Ouest.

11. Civisme et vie politique. Par Eugène L'Heureux, M.S.R.C.

La vie publique n'est pas ce qu'elle devrait être, parce que les citoyens manquent de civisme. — Définitions du civisme. — Distinction entre civisme et patriotisme. — Le civisme en démocratie. — Obstacles à la conception, à la propagation et à la pratique du civisme, qui proviennent (1) de l'imperfection humaine, (2) de notre histoire compliquée, (3) de notre constitution fédérative, (4) de nos mœurs politiques et (5) du silence de nos programmes scolaires sur ce point. — Puisque nous vivons en démocratie, probablement pour longtemps encore, il faut nous occuper davantage de faire l'éducation civique de notre peuple, dans la famille, dans les écoles et après la scolarité.

12. La critique. Par Léopold Houlé, M.S.R.C.

La critique a-t-elle démérité ou dépassé ses droits ? Au fait, on a discuté, ces derniers temps à la radio, cet important sujet. Le débat s'est fait en même temps que la presse française accusait un auteur, M. Cocteau, de méconnaître la nécessité de la critique. Celle-ci ne doit pas être un élément d'acrimonie, mais un guide, une conseillère, un recours; il faut pour cela, disait LaBruyère, une longue préparation dans les études, de la culture et de la réflexion.

13. Pierre-Noël Levasseur, statuaire de la dynastie. Par Gérard Morisset, M.R.S.C.

En étudiant la lignée des Levasseur, on constate que l'un d'eux, Pierre-Noël, s'est livré presque exclusivement à la statuaire; statuaire religieuse et statuaire de proues de navires. A l'aide de documents nouveaux, l'auteur essaie de départager les sept artisans du bois qu'on appelle généralement « les Vasseurs » et met en relief la figure méconnue du statuaire de la lignée.

14. L'œuvre de François-Xavier Duplessis. Par Guy Sylvestre, M.S.R.C.

Présentation et analyse de l'œuvre de François-Xavier Duplessis (1694-1771), jésuite canadien, qui fut un prédicateur célèbre en son temps et a publié *Avis et pratiques pour profiter de la mission et pour en conserver le fruit; Lettre du P. Duplessis . . . au sujet des calomnies publiées contre lui par l'auteur des* Nouvelles ecclésiastiques; et dont Joseph-Edmond Roy a publié des lettres en 1892.

15. Un disciple canadien de Frédéric Le Play, Léon Gérin. Par Arthur Saint-Pierre, M.S.R.C.

L'Auteur rappelle le séjour que fit à Paris notre sociologue canadien; comment il prit contact avec l'école de la paix sociale en fréquentant les maîtres et s'en fit le propagandiste enthousiaste après son retour au pays.

SECTION II.—ENGLISH LITERATURE, PHILOSOPHY, SOCIAL SCIENCES, ETC.

Monday, June 1

10:00 A.M.—1. General Meeting of the Society.

11:00 A.M.—2. Presidential Address: The Canadian University. By A. R. M. Lower, F.R.S.C.

2:00 P.M.

1. Business Meeting.

2. Symposium on Canadian Aid to Underdeveloped Countries.

   (*a*) Under the Technical Assistance Programme of the United Nations. By F. R. Scott, F.R.S.C.

This paper examines the purpose and development of the expanded Technical Assistance Programme launched by the United Nations in 1949. Some contrasts with the Colombo Plan and with the United States economic aid programmes are noted, and attention is drawn to the difficulties in transferring industrial and social techniques from one country to another. Canada's role as a principal donor to these programmes is assessed, and the value of linking welfare activities with international organizations is emphasized.

   (*b*) Under the Colombo Plan. By R. A. MacKay, F.R.S.C.

Some problems experienced in the execution of Canada's programme of economic aid and technical co-operation under the Colombo Plan.

3. The Authenticity of the Letters between Abelard and Héloise. By J. T. Muckle, F.R.S.C.

Tuesday, June 2

9:00 A.M.

1. Joint Meeting with Section I on "English and French Studies in French and English Canada." Paper from Section I by Maurice Lebel, F.R.S.C. Paper from Section II by W. E. Collin, F.R.S.C.

2. The Battle of the Books: Some Remarks on Censorship. By Henry Alexander, F.R.S.C.

The Senate investigation of the sale and distribution of salacious and indecent literature (*sic*) and two recent prosecutions in the courts have raised the question of the control of books, magazines, and theatrical performances by some form of censorship or legal enactment or a combination of both these methods. The present situation is admittedly unsatisfactory. Censorship of printed material is in effect imposed sporadically by (1) the power exercised by the Department of Inland Revenue by which books and magazines considered unsuitable for circulation may be refused entry into the country; (2) the prosecution of distributors who are responsible for the circulation of material that may have crossed the borders or have been printed

in Canada; (3) provincial censorship, for instance in Quebec. There is at present a strong movement to introduce federal or provincial censorship or to tighten up the law with regard to obscenity, at present not defined in the criminal code. Both these remedies have obvious difficulties and dangers.

2:00 P.M.

1. Jung's Interpretation of Religion. By James S. Thomson, F.R.S.C.

C. G. Jung interprets religion in terms of relation between the conscious and the unconscious levels of the mind. He introduces his doctrine of the "collective unconscious," which survives as a hereditary factor in individual minds. The contents of this ancestral unconscious can be traced in folk myths, which are said to possess a remarkable identity of character and fall into definite patterns. The same patterns reappear in the individual unconscious of people today and find expression in dreams. Myth and symbol are the language of religion and provide a clue to its interpretation. The spontaneous nature of these aspects of human consciousness indicate the necessity for religion, which persists in relation to a fundamental activity of our nature.

2. Some Aspects of the *Oedipus Tyrannus*. By R. E. K. Pemberton. Presented by J. J. Talman, F.R.S.C.

This paper discusses such problems as: Is Oedipus a Tyrant?; the messenger scene with special reference to the part of Jocasta; the character of Creon; the closing scene.

3. Modernism in the Seventeenth-Century Platonists. By H. L. Stewart, F.R.S.C.

The group associated chiefly with a single Cambridge college in the middle and late seventeenth century, to whom the name "Cambridge Platonists" has been attached, set forth theories in some respects very similar to those condemned by Pope Pius X in 1907 as "Modernism." But the contrasts are no less notable. This paper will examine how these movements, separated by two and a half centuries, resembled each other and how they differed.

4. Early Creative Literature in Western Ontario. By Carl Klinck. Presented by Fred Landon, F.R.S.C.

A study of some of the earliest published works of poetry and prose fiction produced in Western Ontario, with special emphasis upon literary influences from Great Britain and the United States, and upon distinctive characteristics on developments of literature originating in this region.

Wednesday, June 3

9:00 A.M.

1. New Caledonia, The Siberia of the Canadian Fur Trade. By W. N. Sage, F.R.S.C.

Section II

New Caledonia, the north central portion of British Columbia, was given a hard name by the fur traders. Is this reputation deserved? Recent research has shed new light on this isolated district. An attempt will be made to reassess the policies and methods of the North West and Hudson's Bay Companies in New Caledonia and to discuss its position in relation to American and Russian activities on the Pacific Coast.

2. The Snowball Brigade: The Constitutional Significance of the Canadian-Siberian Expeditionary Force. By R. M. A. Vince. Presented by Watson Kirkconnell, F.R.S.C.

3. Some Threads in the Web of Geography. By Carleton Stanley, F.R.S.C.

The paper begins with a quotation from Seneca's *Medea*, mentioning *Ultima Thule*, and predicting that the time will come when all the shores of the Atlantic will be known. *Ultima Thule* was the name given to "land far north of Britain" by Pytheas of Massilia (325-320 B.C.), who also named the triangular landfalls of Britain. His statements were rejected by Strabo, the great geographer, writing in the first century A.D. The paper continues with a general view of Mediterranean geographic lore, East and West, first to sixth centuries A.D. There follows a discussion of: an Irish geography 825; the Norsemen; the first Arab University, and School of Geography, at Cordova, (native city of Seneca's family), 961-76; Idrisi the Arab; the Genoese; and Prince Henry the Navigator and Columbus, who took Seneca's lines for their motto. The general question is then dealt with: How does geography expand? Superficial answers to that question are dismissed.

2:00 P.M.—Business Meeting.

3:00 P.M.—General Meeting of the Society.

SECTION III.—CHEMICAL, MATHEMATICAL, AND PHYSICAL SCIENCES

Summary of Programme

Monday, June 1

11:00 A.M. Business meeting—Room 42, Science Building.
2:00 P.M. Presidential Address and invited lecture—Room 42, Science Building.

Tuesday, June 2. Sub-section meetings as follows:

9:00 A.M. Spectroscopy and Astrophysics—Room 212, Arts Building.
9:00 A.M. Chemistry—Room 221, Arts Building.
9:00 A.M. Mathematics—Room 136, Science Building.
9:00 A.M. Nuclear Physics—Room 222, Arts Building.
2:00 P.M. General Physics—Room 212, Arts Building.
2:00 P.M. Chemistry—Room 221, Arts Building.
2:00 P.M. Mathematics—Room 136, Science Building.

Wednesday, June 3. Sub-section meetings as follows:

9:00 A.M. Solid State Physics—Room 212, Arts Building.
9:00 A.M. Nuclear Physics—Room 222, Arts Building.
11:30 A.M. Business meeting of the Section—Room 42, Science Building.

Monday, June 1

11:00 a.m.—Business meeting, Room 42, Science Building.

2:00 p.m.—Presidential Address and invited lecture—Room 42, Science Building.

1. The Impact of Fourier Series on Applied and Pure Mathematics. By Professor R. L. Jeffery, F.R.S.C.

2. Applications of Fourier Transforms in Physical Problems. By Professor W. H. Watson, F.R.S.C.

Tuesday, June 2

9:00 a.m.—SUB-SECTION SPECTROSCOPY AND ASTROPHYSICS, Room 212, Arts Building. PAPERS 3-15.

3. The Spectrum of the Secondary Component of Capella. By K. O. Wright. Presented by R. M. Petrie, F.R.S.C.

The spectrum of Capella has been described by O. Struve (Proc. Nat. Acad. Sci., Wash., 37, 1951: 327) as a "most baffling astronomical spectrum" since the lines of

the secondary component are difficult to observe and certain anomalies seem to be present. An attempt to disentangle the spectra of the two components is being made at Victoria using spectrophotometric techniques and high-dispersion grating spectrograms. In the region studied to the red of λ5000, the two spectra can be separated by comparing intensity tracings of plates taken at single- and double-lined phases. Both stars are giants; the primary has a spectrum about G5 and the secondary about G0 or slightly earlier. At λ5500 about 0.7 of the light comes from the primary component. In the observed composite spectrum of Capella the lines of the secondary appear broad and shallow. However, when allowance is made for the fact that the secondary component contributes only 0.3 of the light to the spectrum, it is found that lines of each component have approximately the same width and, in this region of the spectrum, the secondary seems to be normal for its type. From differential measurements made on intensity tracings of the spectra and assuming the elements of the orbit given by W. Struve (Z. Astrophys. 17, 1939:61) the ratio of the masses of the two stars, $M_{primary}/M_{secondary} = 1.14$.

4. The Spectrum of the Star A.D.S. 14,864A. By G. J. Odgers. Presented by R. M. Petrie, F.R.S.C.

The spectrum of the star A.D.S. 14,864A has been analysed photometrically and shown to be compounded of a B-type stellar spectrum and a K-type stellar spectrum. A detailed study of the line intensities gives the radii and temperatures of the two components. A comparison made between the black body radiation law and others proposed from considerations of radiative equilibrium definitely favours the former.

5. The Problem of the Emission at Hα in Shell Stars. By Anne B. Underhill. Presented by R. M. Petrie, F.R.S.C.

Observations of Hα and Hβ in some emission-line stars are presented. It is shown that in Be stars the widths of the emission lines Hα and Hβ are directly proportional to wave-length, as is expected according to the hypothesis that these lines arise from an equatorial bulge of the rapidly rotating star. In shell stars, however, the emission at Hα is very much wider than that at Hβ. It is unlikely that width of the Hα emission is due solely to a regular motion such as rotation or expansion of an extensive atmosphere; it must result from some other cause.

6. The Optical Hyperfine Structure of Cadmium. By G. R. Hanes and M. F. Crawford, F.R.S.C.

From an analysis of the hyperfine structure pattern of the Cadium I intercombination resonance line, the wave-number intervals between all components arising from the six principal isotopes of Cadium have been determined. The ratio of the magnetic moments calculated from the splittings of the components of the odd isotopes differs from that obtained from nuclear induction measurements. The spectroscopic anomaly is − 0.9 per cent. The regular spacing of the components of the even isotopes gives an isotope shift of about 0.014 cm^{-1} per addition of two neutrons. For each odd isotope, the centre of gravity of the components lies close to the next lighter even isotope. These data are discussed in terms of theories of nuclear structure.

7. New Forbidden Transitions of the Oxygen Molecule. By G. Herzberg, F.R.S.C.

Two new forbidden transitions of the O_2 molecule have been found. They give rise

to very faint absorption bands overlapping the much stronger forbidden $^3\Sigma_u^+ \leftarrow {}^3\Sigma_g^-$ bands previously described. The upper states are identified as $^1\Sigma_u^-$ and $^3\Delta_u$ respectively, both of which arise from the same electron configuration as the known states $^3\Delta_u^+$ and $^3\Sigma_u^-$. For the $^1\Sigma_u^-$ state the vibrational and rotational constants have been determined. For the $^3\Delta_u$ state the data are quite fragmentary, and only a very few rotational and vibrational constants have been evaluated. The $^3\Delta_u - {}^3\Sigma_g^-$ system is very probably the analogue in free O_2 of the diffuse triplet bands observed in oxygen at high pressure and ascribed to O_4. A number of unidentified features in the spectrum of the light of the night sky agree with predicted emission bands of the $^1\Sigma_u^- - {}^3\Sigma_g^-$ system.

8. Photographic Infra-red Spectra and Molecular Constants of Carbon Dioxide. By G. Herzberg, F.R.S.C., and L. Herzberg.

The absorption spectrum of carbon dioxide in the region 8000 to 12500A has been investigated with a 21 ft. grating, using absorbing paths up to 2000 m. and pressures up to 1 atm. The rotational constants B of the ground state and a number of excited vibrational states of the molecule have been determined with high accuracy, leading to an improved formula for the dependence of B on the vibrational quantum numbers. In this way, improved values for the constant B_e and the CO distance in the equilibrium configuration of the molecule have been obtained. The l-type doubling constants q have been determined for several vibrational Π-states. A new set of vibrational constants have been derived.

9. The Ultra-violet Spectrum of CN and CN^+. By A. E. Douglas and P. M. Routly. Presented by G. Herzberg, F.R.S.C.

The spectrum of a discharge through helium containing a trace of cyanogen has been photographed from 8000A to 1900A with a 21 ft. grating spectrograph. The spectrum shows a large number of previously unrecorded bands in the ultra-violet region. An analysis of these bands shows that many of them can be arranged into six systems. Four of the band systems arise from three previously unknown electronic states (a $^2\Delta_i$ and two $^2\Pi$ states) of CN. The two remaining band systems have been attributed to two $^1\Sigma - {}^1\Sigma$ transitions of the CN^+ molecule with the lower state being common to the two systems. A considerable extension of the well-known $^2\Sigma - {}^2\Sigma$ system of CN has also been observed, and additional information regarding the dissociation energy of the molecule has resulted from the analysis of this system.

10. The Near Infra-red Spectrum and the Internuclear Distances of N_2O. By A. E. Douglas and C. K. Möller. Presented by G. Herzberg, F.R.S.C.

The infra-red spectra of $N^{14}N^{14}O^{16}$ and $N^{15}N^{14}N^{16}$ have been measured from 4750 cm^{-1} to 4330 cm^{-1} with a high resolution grating spectrometer. The rotational structure of the $2\nu_2$, $2\nu_1+\nu_3$, $\nu_1+2\nu_2+\nu_3$, and $2\nu_3+\nu_2-\nu_2$ bands have been measured for both molecules. These measurements are sufficient to determine the rotational constants α^1, α_2, and α_3, and hence B_e for both molecules. From the values of B_e, the equilibrium N–N and N–O distances in N_2O have been determined.

11. Vibrational Transition Probabilities of Diatomic Molecules: Some Results. By W. R. Jarmain, P. A. Fraser, and R. W. Nicholls. Presented by A. D. Misener, F.R.S.C.

Vibrational transition probabilities for band systems of N_2, N_2^+, NO, O_2^+ and other diatomic molecules of astrophysical interest will be displayed in v', v'' array. The methods of calculation of these quantities will be briefly described and indicated.

12. The High-Voltage Arc in an Argon-Nitrogen Mixture. By R. W. Nicholls. Presented by A. D. Misener, F.R.S.C.

Commercial lamp bulbs filled with argon-nitrogen (99.5-0.5, at 600 mm. pressure) mixtures, whose filaments were destroyed, have been excited as high-voltage a.c. arcs at a frequency of 60 c.p.s. (The voltages employed lay between 1 and 2 kv. and currents of up to 30 ma. were drawn.) The electrical characteristics (ordinate: rms current, abscissa: rms voltage) of such arcs have been studied and found to be Z-shaped. Preliminary spectroscopic studies of the "flames" of low-current arcs have been made in the glass region (λλ3500–12,000A). The results so far show that selected bands of the N_2 second positive and first positive systems only are excited, and appear in photographs with exposures from 1 to 24 hours.

The most strongly observed bands are:

Second positive system	(0,1) (0,2) (0,3) (0,4)
$C^3\Pi_u \quad B^3\Pi_g$	(1,3) (1,4) (1,4) (1,5)
First positive system	(1,0)
$B^3\Pi_g \quad A^3\Sigma_u^+$	(2,0) (2,1)
	(3,0) (3,1) (3,2)

Surprisingly low vibrational excitation is observed. A possible indirect excitation mechanism involving the metastable $a^1\Pi_g$, $a'^1\Sigma_u^-$ and w states is suggested to explain the results.

13. Raman Spectroscopy of Gases at High Dispersion. By E. J. Stansbury, J. Romanko, and H. L. Welsh, F.R.S.C.

The accurate determination of molecular constants from the Raman spectra of low-pressure gases has necessitated the development of Raman sources of very high intensity. A Raman tube of large volume, illuminated by high-intensity water-cooled mercury lamps, is used; the efficiency is increased many-fold by a system of concave mirrors to give multiple reflections inside the tube. The spectrograph, a Littrow-type instrument with two glass prisms, has alternative reciprocal linear dispersions of 15.6 and 10.5 cm^{-1} per mm. at 4358A. The speed of the spectrograph is increased fifteen times by an image-slicer in front of the slit and a cylindrical lens in front of the photographic plate.

14. The Rotational Raman Spectrum of Ethylene. By T. Feldman, J. Romanko, and A. McKellar, F.R.S.C.

The pure rotational Raman spectrum of ethylene has been photographed using the equipment described in the previous abstract (No. 13). The exciting line was Hg λ4358 and the gas pressures were two and three atmospheres.

Previous investigators (Lewis and Houston, Phys. Rev., 44, 1933: 903) analysed their lower-dispersion spectrum considering the molecule as a symmetric top. The present higher-dispersion spectrograms are quite complex and the rotational structure shows definite departures from that of a symmetric-top molecule. Methods of analysing the spectrum on the basis of an asymmetric top model are discussed.

15. Theoretical Calculation of Fundamental and Overtone Coefficients of the Pressure-Induced Absorption of Molecular Hydrogen. By F. R. Britton and M. F. Crawford, F.R.S.C.

The dipole moment induced in a H_2-H_2 system during collision is calculated using a first order perturbation method and also a variational method with a trial function properly symmetrized for the system. The matrix elements required for absorption coefficients are derived to a first approximation from this moment. Matrix elements have been evaluated for the fundamental 1–0 vibrational band and for bands observed in the first overtone region, the 2–0 overtone and 1–0 simultaneous transition bands. The ratio of the calculated coefficients for the two parts of the overtone band and the ratio for the overtone bands to the fundamental agree with experiment; but in this approximation all coefficients are smaller than experimental values.

9:00 a.m.—SUB-SECTION CHEMISTRY, Room 221, Arts Building. PAPERS 16-29.

16. On the Motions of Model Particles in Velocity Gradients. By R. St. J. Manley, B. J. Trevelyan, and S. G. Mason, F.R.S.C.

Studies of rotational motions of rigid spheres and cylinders, two-body collisions of multiple spheres, and orientations and interactions of multiple cylinders suspended in a liquid subjected to shear are described.

The angular velocities and spherical elliptical orbits observed for single cylinders are in close accord with Jeffery's theoretical equations.

Measured collision frequencies agree well with values calculated from a simple geometrical treatment of the collision process. The detailed history of the transitory doublets so formed has been determined, making it possible to calculate the distribution function of doublet lives. Good agreement is shown between various measured and calculated doublet lives.

A steady-state orientation distribution is established in suspensions of cylinders, but differs from values calculated from Jeffery's equations using the conventional assumptions of distribution of orbits. The distribution established is determined by the abrupt changes in orbit constants resulting from two-body collisions.

These phenomena are of importance in theories of viscosity, flow anisotropy, and orthokinetic coagulation.

17. Argon 38 in Pitchblende Minerals and Nuclear Processes in Nature. By W. H. Fleming and H. G. Thode, F.R.S.C.

The isotopic constitution of argon extracted from four pitchblende samples of different age and uranium concentration has been determined. The A^{36}/A^{38} ratio was found to vary by over 300 per cent with the greatest deviations from normal occurring in the ores with high uranium content. It is suggested that A^{38} has been produced in considerable quantities in these ores by nuclear reactions involving α particles and/or the spontaneous fission neutrons.

18. The Occurrence of Neutron Fission in Nature. By W. H. Fleming and H. G. Thode, F.R.S.C.

Xenon extracted from pitchblende has been shown by mass spectrometric analysis to consist mainly of fission product xenon resulting from the spontaneous fission

of U^{238}. Variations in the mass patterns of xenon from different pitchblendes indicate that there is also a contribution from neutron fission of U^{235} particularly in ores of high uranium content.

19. The Measurement of Some Ionic Diffusion Coefficients with Radioactive Tracers. By J. A. Davies. Presented by G. C. Laurence, F.R.S.C.

A capillary cell method has been employed to study the rate of diffusion of several monovalent cations in aqueous electrolytes at 25°C. Data have been obtained for Na^{24}, K^{42}, and Cs^{137} ions in sodium chloride solution, and for Na^{24} and Cs^{137} ions in potassium chloride solution, at chloride concentrations varying from 0.01 N to 4.0 N. The results in dilute solution are in satisfactory agreement with the Onsager equation, but marked deviations occur above 0.1 N.

20. Determination of the Absolute Amount of Tritium by Microcalorimetry. By T. J. Hardwick. Presented by G. C. Laurence, F.R.S.C.

A microcalorimetric method for the absolute determination of tritium is described. The apparatus has been so designed that independent measurements of the heat output of the tritium may be made by both the dynamic and the static methods. A heat output of 600 microwatts has been measured with a reproducibility of ±1 per cent.

21. Electrophoretic Studies of Resin Emulsions. By L. A. Munro, F.R.S.C. and F. H. Sexsmith.

Electrolyte concentration rather than pH, concentration of resin particles or dispersity, is the most significant variable affecting the mobility of polyvinyl acetate emulsions. The mobility-electrolyte concentration curves for latices prepared with nonionic and mixed nonionic and anionic emulsifiers indicate micelle formation at low electrolyte concentrations. Zeta potentials calculated for a typical latex show the potential drop in the double layer to be of the order of 10^{-7} volts.

Accelerated stability (settling) tests with the addition of increments of salt indicated that such stability is related to electrophoretic mobility in most of the systems studied.

22. The Dielectric Properties of Ethylchloride Adsorbed on Non-Porous TiO_2. By M. Waldman, J. A. Snelgrove, and R. McIntosh, F.R.S.C.

The dielectric properties of ethylchloride adsorbed on non-porous T_iO_2 were investigated between − 20 and + 15°C. at a frequency of 3.7 mc/sec. The data show significant differences from those obtained using porous silica gel. Linear sections of the plots of Δc vs. volume adsorbed were found. The first discontinuity of the slope occurred at a volume adsorbed corresponding closely with V_m values predicted by the Hüttig and B.E.T. equations. The measurement of dielectric properties appears useful for the establishment of the V_m value, and for the general study of adsorbed matter.

23. The Effect of Adsorbates on the Electrical Resistance of Activated Carbon Rods. By W. Smeltzer and R. McIntosh, F.R.S.C.

Data are presented showing that the electrical resistance of activated carbon rods is altered by adsorbed gases. Each member of a series of aliphatic hydrocarbons brought about a decreased resistance, which approached a limiting value as the surface became nearly saturated. The data for six hydrocarbons showed that the measured effect is proportional, for any given quantity adsorbed, to the number of carbon atoms in the hydrocarbon molecule. Chemi-sorbed oxygen altered the resistance of the rod, but not the effect of the hydrocarbons. A qualitative discussion of these results is attempted.

24. Kinetics of the Thermal Decomposition of 22′ Bis-Azo-Iso-Butyronitrile. By M. Talât-Erben and S. Bywater. Presented by I. E. Puddington, F.R.S.C.

The decomposition of the polymerization initiator 22′ bis-azo-isobutyronitrile has been followed by measurements of the ultra-violet spectra of the reactant and products. The kinetics are discussed in detail.

25. The Reactions of Active Nitrogen with the Butanes. By R. Back and C. A. Winkler, F.R.S.C.

The reactions of active nitrogen with n-butane and iso-butane have been studied at hydrocarbon flow rates between 5×10^{-7} and 2×10^{-5} moles per second, and at temperatures of 100° and 250°C.

The main product of the reactions is hydrogen cyanide. Small quantities of ethylene, acetylene, and ethane were also found. The rate constants for the reactions at 100°C. were 9×10^4 and 4×10^6, and at 250°C. were 6×10^6 and 9×10^6 litre $mole^{-1}$ sec^{-1}, for n-butane and iso-butane respectively (calculated on assumption of stream-line flow in the system). The corresponding activation energies are approximately 4000 and 2000 calories per mole respectively.

26. The Quenching of Mercury Resonance Radiation. By B. deB. Darwent, F.R.S.C., and M. K. Phibbs.

The quenching cross-sections of some inorganic compounds and a large number of substituted paraffinic and unsaturated compounds have been measured by the method of Zemansky. In the saturated compounds a striking effect of substituents on σ_Q^2 is noted; thus the introduction of fluorine appears to reduce the quenching efficiency whereas oxygen and, to a greater extent, sulphur, nitrogen, and mercury increase the efficiency. The quenching cross-sections of olefins increase with increasing molecular weight but they are unaffected by branching of the carbon skeleton or by the presence of multiple double bonds, whether isolated or conjugated.

27. The Study of Rapid Gas-Phase Reactions by Means of a Scanning Mass-Spectroscope. By Edouard Léger and Cyrias Oueliet, F.R.S.C.

Panoramic mass spectra are seen on the screen of a cathode-ray tube and photographed by means of a movie camera. A continuous sample of the reacting gases travels as a molecular stream from the reaction chamber to the ionizing source. By scanning the spectrum several hundred times per second, it is possible to follow the fate of the chemical species involved. Rapid oxidations, such as occur in cool flames, are being investigated by this method.

28. Cool Flames in Hydrocarbon Oxidation. By J. Bardwell. Presented by J. W. T. Spinks, F.R.S.C.

The conditions of temperature and pressure that induce spontaneous inflammation of butane–oxygen mixtures have been determined in a constant-volume apparatus. Between 250°C. and 400°C. the oxidation is accompanied by the passage of "cool flames" through the reaction mixture. The flames follow one another at regular intervals and produce considerable quantities of aldehydes and peroxides. The frequency of their occurrence is an exponential function of temperature.

29. Reactions of Radicals Produced by Betatron Radiations. By R. W. Hummel, G. R. Freeman, A. B. Van Cleave, and J. W. T. Spinks, F.R.S.C.

The oxidation of aerated aqueous solutions of ferrous ammonium sulphate and the production of phenol from aqueous solutions of benzene have been studied using Co^{60} gamma-rays and 24 Mev. peak energy *x*-rays from a betatron. For both reactions, the behaviour at high photon energies has been shown to be very similar to that at lower photon energies. The results are discussed in terms of radical reactions.

9:00 a.m. and **2:00 p.m.**—SUB-SECTION MATHEMATICS, Room 136, Science Building. PAPERS 30-44.

30. Absolute Summability Functions. By G. G. Lorentz and M. S. Macphail. Presented by H. S. M. Coxeter, F.R.S.C.

For the discussion of absolute summability functions of a method of summability, convergence functions of a series with positive terms Σu_n are introduced. $\Omega(n)$ is a convergence function of Σu_n if for each sequence of integers $n_1 < n_2 < \ldots$ with counting function $\omega(n) \leqslant \Omega(n)$ the series Σu_{n_k} is convergent. Properties of convergence functions are discussed, and absolute summability functions of Hausdorff, Riesz $R(\lambda_n, k)$ and Abel $A(\lambda_n)$ methods of summation are determined.

31. Convex Sets in Linear Topological Spaces. By I. Halperin. Presented by R. L. Jeffery, F.R.S.C.

Two theorems for linear normed spaces, namely Mazur's theorem on supporting hyper-planes and two of Eidelhert's theorems on separating hyper-planes, are proved for general linear topological spaces. The proofs are new and elementary, real and complex scalars are admitted.

32. Uniform Convexity in Function Spaces. By I. Halperin. Presented by R. L. Jeffery, F.R.S.C.

Although the L-spaces determined by a single weight functions are a generalization of classical L^p-spaces, not even the reflexive ones are all uniformly convex. In this paper it is determined precisely which are uniformly convex.

33. A Composite Hölder Inequality and Its Application to Function Spaces. By I. Halperin. Presented by R. L. Jeffery, F.R.S.C.

A supreme problem of the Hölder type is solved for the case of more than one weight function. This permits an extension of previous studies to L-spaces determined by a family of weight functions.

34. The Theory of *L*-Spaces. By H. W. Ellis and I. Halperin. Presented by R. L. Jeffery, F.R.S.C.

The Theory of *L*-spaces given by Halperin for numerical-valued functions is now extended to functions valued in a general Banach space. The results are actually obtained for a new class of function spaces of which the previous *L*-spaces are a special case and include the results obtained in the classical case by Bochner and Taylor, Pettis, Phillips and Dieudonné.

35. A Remark on Curves of Order n in n-Space. By P. Scherk, F.R.S.C.

The linear order of a curve in real projective n-space is the upper limit of the number of points which it may have in common with any linear $(n-1)$-space. This order is not less than n. The Jordan curves C^n of order n in n-space are natural generalizations of convex curves. It is proven that every C^n can be uniformly approximated by curves C^n which are in a certain sense differentiable.

36. Groups of Formal Power Series with Coefficients in a Commutative Ring. By S. A. Jennings. Presented by R. D. James, F.R.S.C.

Let G, $\tilde{G}$, and $\hat{G}$ be respectively the groups under substitution of formal power series of the forms

$$x + \sum a_n x^n \qquad (n = 2, 3, \ldots \infty),$$

$$x + \sum \frac{a_n x^n}{n!} \qquad (n = 2, 3, \ldots \infty),$$

$$x\left(1 + \sum \frac{a_n x^n}{n!}\right) \qquad (n = 1, 2, \ldots \infty),$$

where the coefficients a_n lie in an arbitrary commutative ring R. General properties of G, $\tilde{G}$, and $\hat{G}$ are discussed, and the relationship between the structure of the ring R and the group-theoretical properties of these groups is investigated.

Let G_1, $\tilde{G}_1$, and $\hat{G}_1$ be the groups obtained by specializing R to be the ring of integers, and let P_α, $\tilde{P}_\alpha$, $\hat{P}_\alpha$ be the normal subgroups of G_1, $\tilde{G}_1$, and $\hat{G}_1$ respectively, consisting of those power series for which a_n is divisible by p^α where p is a prime. It is proved that

$$P_\alpha/P_{\alpha+1}, \quad \tilde{P}_\alpha/\tilde{P}_{\alpha+1}, \quad \hat{P}_\alpha/\hat{P}_{\alpha+1}$$

are abelian, for $\alpha \geqslant 1$, and the commutator structure of G_1/P_1, $\tilde{G}_1/\tilde{P}_1$ and $\hat{G}_1/\hat{P}_1$ is investigated. It appears that while $\hat{G}_1/\hat{P}_1$ is of relatively simple structure, $\tilde{G}_1/\tilde{P}_1$ is more complicated, and G_1/P_1 is very complicated in its structure.

37. The Closest Packing of Spheres in Ordinary Space. By A. P. Dempster. Presented by H. S. M. Coxeter, F.R.S.C.

This is a completely elementary proof that the closest possible packing of equal spheres about lattice points occurs when the centres form the face-centred cubic lattice. The result is equivalent to the classical theorem that, if $f(x, y, z)$ is a positive

definite ternary quadratic form of determinant D, then integers x, y, z (not all zero) exist such that

$$f(x, y, z) < (2D)^{\frac{1}{2}},$$

with strict inequality except when $f(x, y, z)$ is equivalent to

$$(2D)^{\frac{1}{2}} (x^2 + y^2 + z^2 + yz + zx + xy).$$

38. Linear Functionals on Cross-Spaces. By G. G. Lorentz. Presented by H. S. M. Coxeter, F.R.S.C.

Let $B = \{x\}$ be a Banach space, $K = \{f\}$ a Banach lattice as described by Kantorovitch. In an asymmetric way, a cross-space $B \otimes_\delta K$ is defined. For elements of the form

$$\bar{f} = \sum_{k=1}^{h} x_k \otimes f_k, \quad x_k \in B, \quad f_k \in K,$$

we let

$$\delta(\bar{f}) = \inf \left\| \sum_{k=1}^{h} \|x_k\|_B \, |f_k| \right\|_K,$$

the infimum being taken for all possible representations of $\bar{f}$ of this form. Representations of bounded linear functionals on spaces $B \otimes_\delta K$ are discussed. In the case when $B \otimes_\delta K$ is a vector-valued space $\Lambda(\phi, p)$, similar results were obtained by the author and D. G. Wertheim.

39. Addition of Sets of Integers and Multiplicity of Representation. By G. G. Lorentz. Presented by H. S. M. Coxeter, F.R.S.C.

If A, B are infinite sets of integers, the elements n of the set $C = A + B$ may have many representations of the form $n = a + b$. Let $\rho(n)$ be the number of different representations of this kind. Several simple theorems are proven which show that $\rho(n)$ is large on sets of considerable density. For example, if the asymptotic density $\alpha = d(A)$ of A is positive, there is a set $D < C$ with $d(D) \geqslant \alpha$ and $\rho(d) \to \infty$; if also $d(B) > 0$, there is a set $D < C$ with $d(D) \geqslant \alpha$ and $\rho(d) \geqslant \omega(d)$, where $\omega(n)$ is any fixed function with $\omega(n) = o(n)$.

40. The Inversion of Convolution Transforms by Differential Operators. By Charles Fox. Presented by W. L. G. Williams, F.R.S.C.

Since the discovery by E. L. Post (see D. V. Widder *The Laplace Transform*, Princeton, 1941, p. 276) that the Laplace transform can be inverted by a differential operator, much work has been done by Widder, Hirschman, and others on this type of inversion. Consider the integral equation

$$f(x) = \int_0^\infty K(x, v) g(v) \, dv, \tag{1}$$

where $K(x, v)$ is a kernel of known form and $f(x)$ is given. I have obtained the following result:

A. Let $h(x)$ be a generalized Fourier kernel (see E. C. Titchmarsh *Theory of Fourier Integrals*, Oxford, 1937, chap. 8) which satisfies a differential equation of type

$$L(x, D)y = -u^2 y,$$

where D denotes the operation d/dx and L is a function of x and D only, i.e. does not contain u. Many Fourier kernels satisfy equations of this type.

B. Let

$$K(x, v) = \int_0^\infty \frac{h(xu)\, h(vu)}{E(u)}\, du,$$

where

$$E(u) = \prod_{n=1}^{\infty} (1 + u^2 a_n^{-2}),$$

and

$$\sum_{n=1}^{\infty} a_n^{-2}$$

is convergent.

Under suitable conditions of convergence, (1) can then be inverted by the following differential operation:

$$\prod_{n=1}^{\infty} \left\{1 - \frac{L(x, D)}{a_n^2}\right\} f(x) = g(x). \tag{2}$$

Equation (1) is thus solved for $g(x)$ in terms of $f(x)$.

41. A Fundamental Theorem of the Modular Representation Theory of the Symmetric Group. By G. de B. Robinson, F.R.S.C.

For some years it has been known that this theory depends on the hook structure of the Young diagram. It turns out that the indecomposables of the regular representation are lattices of their ordinary components. The structure of such a lattice is based upon the theorem that the total number of kp-hooks ($k = 1, 2, 3, \ldots$) removable from a Young diagram $[\alpha]$ is equal to its weight. The proof is based upon the subsidiary theorem that the total number of k-hooks ($k = 1, 2, 3, \ldots$) removable from the star diagram $[\alpha]^*$ is equal to the number of nodes contained in it, i.e., to the weight w of $[\alpha]$.

42. Some Remarks on Laplace's Method. By P. G. Rooney. Presented by M. Wyman, F.R.S.C.

The results of D. V. Widder's *The Laplace Transform* (Princeton, 1941) on the asymptotic evaluation as $k \to \infty$ of integrals of the form

$$\int_a^b e^{kh(x)} \phi(x)\, dx,$$

where $h(x)$ has a simple maximum at a point c of (a, b), are generalized in two directions. First, $h(x)$ is allowed to have a higher order maximum at c (i.e.

$h^{(n)}(c) = 0$, $n = 1, 2, \ldots, 2m - 1$, $h^{(2m)}(c) < 0$), and $\phi(x)$ to have a zero of arbitrary order there. Secondly, Widder's results are generalized to integrals of the form

$$\int\int_R e^{k\phi(x,y)}\psi(x, y)\, dx\, dy,$$

where (x, y) has a simple maximum at a point (a, b) interior to an open set contained in R.

43. Bessel Expansions of the Confluent Hypergeometric Functions. By T. E. Hull, C. A. Swanson, and D. A. Trumpler. Presented by R. D. James, F.R.S.C.

Solutions of a given differential equation can be linked with those of another through an integral equation of the Volterra type. With suitable modifications, the method of successive substitutions then leads to expansions of the solutions of the given equation. This procedure is used to expand the solutions of the confluent hypergeometric equation in series of Bessel functions. Various generalizations of the method are discussed briefly and a few special results are given.

44. Positive Representations by Certain Ternary Quadratic Forms. By W. H. Gage. Presented by R. D. James, F.R.S.C.

The number of representations of a positive integer in a form such as $xy + yz + 2zx$ has been found in the case where x, y, z are all non-negative integers (cf. Bull. Amer. Math. Soc., vol. 48, 1942, pp. 898–900). The author has now investigated representations in these forms in the case where x, y, z are not all positive but are subject to certain restrictions.

9:00 a.m.—SUB-SECTION NUCLEAR PHYSICS, Room 222, Arts Building. PAPERS 45-71.

45. Further Observations on Cd^{105} and Ag^{105}. By F. Allan Johnson. Presented by J. S. Foster, F.R.S.C.

The isotope Cd^{105} (55 min.) has been investigated further using a lens spectrometer. Beyond the end-point of the positron continuum (1.695 ± 0.005 Mev.) three weak internal conversion peaks have been found. These correspond to γ-rays of energies 2.277, 2.045, and 1.907 Mev.

Using a 180° permanent magnet spectrograph of high resolution, internal conversion lines corresponding to the following γ-rays energies have been found: 25.50, 263.0, 292.5, 307.8, 311.2, 317.1, 320.5, 340.7, 433.4 and 606.7 kev. In addition lines at 23.87 and 26.94 kev. have tentatively been assigned as the L_I and M_I conversion lines of a 27.69 kev. γ-ray.

In a similar manner lines assigned to Ag^{105} have been recorded. These correspond to γ-rays of energies 64.0, 280.8, 319.4, 331.5, 344.9, 392.6 and 443.2 kev., of which that of 331.5 kev. has not been reported previously.

46. Conversion Electrons of Au^{193} and Au^{192}. By G. T. Ewan and A. L. Thompson. Presented by J. S. Foster, F.R.S.C.

Au^{192} and Au^{193} have been separated as decay products from Hg isotopes prepared by proton bombardment of gold targets in the McGill cyclotron.

Conversion lines observed in Au^{192} were assigned to γ-rays of energies 99.7, 112.3, 155.5, 173.3, 185.9, 255.1, 267.9, 316.4, and 439.6 kev., all converted in Pt. The measured half-life of Au^{192} is 17.4 hours. A possible decay scheme for Au^{192} will be discussed.

Conversion lines observed in Au^{192} were assigned to γ-rays of energies 137, 158, 168, 188, 205, 282, 296, 316, 402, 415, 437, 467, 588, 612, 765, and 1135 kev., all converted in Pt. The measured half-life is 4.8 hours.

47. New Short-Lived Transitions in Gold, Mercury, and Thallium. By A. Henrikson, S. W. Breckon, and J. S. Foster, F.R.S.C.

An isomeric transition in Tl^{197} (0.54 ± 0.01 sec.) is assigned on basis of thresholds for protons on Hg and Tl. The single gamma at 384 ± 6 kev. is measured by a NaI spectrometer using a modified Hofstadter technique. The total-conversion coefficient of 2.7 and lifetime-energy relation point to M3 multiple radiation.

$Au^{191-193}$ (2.0 ± 0.3 sec.; no gammas observed) is observed by the same procedure.

Hg^{194} (0.40 ± 0.02 sec.; gammas at 134 ± 4 and 48 ± 4 kev.) is assigned from similar thresholds on Au and Hg targets. The lifetime-energy relation labels the higher energy gamma as M3 or E3.

48. The Gamma Spectrum of Re^{188}. By C. C. McMullen and M. W. Johns. Presented by A. B. McLay, F.R.S.C.

The gamma spectrum of Re^{188} has been studied with the large Siegbahn-type beta spectrometer by examining the photoelectrons ejected from a 19 mg/cm² lead radiator. Gamma energies in Mev. and relative intensities have been determined as follows: .1555 (400), .4780 (10), .6330 (15), .7657 (2), .8267 (5), .9308 (6), 1.136 (1), 1.610 (2). The angular correlation function has been determined for the cascades involving gamma-rays of energies greater than .2 Mev. There is strong evidence from this function for a weak position component in the decay of Re^{188}.

49. Neutron Capture Cross-Section of Em^{222}. By A. P. Baerg. Presented by G. C. Laurence, F.R.S.C.

Measurements have been made of the cross-section of Em^{222} (Rn) for slow neutron capture in the NRX reactor to form Em^{223} which has not been previously reported. This nuclide may be estimated to have a half-life of about 5 min., decaying by β-emission through Fr^{223} to Ra^{223} which is an α-emitter of 11.2 day half-life. The production of Em^{223} was conveniently measured by the growth of the Ra^{223} during the irradiation. In three experiments an average value of 0.7² barn was found for the cross-section of Em^{222}.

50. Study of the $D(p,\gamma)H^3$ Reaction. By E. C. Critoph, G. M. Griffiths, J. B. Warren. Presented by G. M. Volkoff, F.R.S.C.

Thin heavy ice targets have been bombarded with protons and the capture gamma-rays detected with a scintillation counter. The gamma-ray energy at different bombarding energies is in excellent agreement with recent mass values. The cross-section has been measured over the proton energy range 200 kev. to 2 Mev. The measured Doppler Shift arising from the c.g. motion is in good agreement with the calculated value, so providing an upper limit to the lifetime of the system. The angular distribution has been measured accurately and is a pure "$\sin^2\theta$" distribution,

the small residue in the forward direction being due to neutron emission from knock-on deutrons. This confirms the absence of any *l–s* coupling and compound nucleus formation.

51. Nuclear Gamma-Ray Absorption in Carbon and Aluminum. By R. N. H. Haslam, R. J. Horsley, H. E. Johns, F.R.S.C., and L. B. Robinson.

The total cross-section for the absorption of high energy gamma-rays by carbon and aluminum has been determined as a function of photon energy by means of nuclear detectors. The nuclear absorption is obtained by subtracting from the total absorption the known absorption produced by Compton and Pair processes. This nuclear absorption shows a resonance behaviour. The integrated nuclear cross-sections are considerably lower than predicted. The contribution of nuclear scattering is found to be negligible. Differences in results as determined by different detecting reactions are discussed. The absorption mechanism can be represented by a continuous absorption on which is superimposed absorption peaks.

52. The Radioactive Isotopes Al^{24}, p^{28}, Cl^{32}. By S. W. Breckon, W. M. Martin, A. Henrikson, J. S. Foster, F.R.S.C.

New isotopes, P^{28} and Cl^{32}, each of half-life 0.33 sec., have been produced in (p,n) reactions with protons of energy above 15 Mev. These nuclei represent an extension of the series $A = 4n$, $Z = 2n + 1$, previously terminated in Al^{24} where Birge (Phys. Rev., 85, 1952A:753) observed delayed heavy particle emission. Using a scintillation spectrometer in conjunction with the pneumatic target extractor, we have found that each of these isotopes possesses a complex gamma-ray spectrum identifiable in part with the known levels in the respective daughter nuclides Mg^{24}, Si^{28}, S^{32}. The search for alphas and positrons will be discussed.

53. Apparatus for the Observation of Spin Echos. By G. J. B. Crawford. Presented by J. S. Foster, F.R.S.C.

This system contains a square wave-pulser giving up to four pulses per cycle ranging from 3 μsec. to 50msec. in width. Repetition rates are from 0.1 to 100 c.p.s. The pulses gate the buffer of a 3.5 mc. oscillator and high power r.f. bursts are obtained from a multiplier.

The sample lead is essentially a tuned circuit.

The pre-amplifier is gated to close during the pulses. A new mixer circuit and 10.7 mc. IF amplifier 200 kc. wide follow. The over-all gain is approximately 10^6 having a noise figure of 1:5 for a 0.5 μvolt input. An oscilloscope directly follows the detector.

Proton echos have been observed.

54. The Origin of Simple Stars Induced by Cosmic Rays in Photographic Emulsions. By R. Courtemanche, Z. Lechno-Wasiutynska, and P. Demers, F.R.S.C.

Simple stars are defined as comprising only one long branch (H, or α in 5 per cent of cases) and a recoil prong (Can. J. Res., A28, 1950:628–55). They seem to make up 5 to 15 per cent of observable disintegrations at all altitudes, but to be distinguished from elastic recoil protons they require a small grain and careful ob-

serving. In most cases they should be ascribed to (n,p), (n, α), (n, np), (n, nα), (γ, p) or (γ,α) reactions. Considerations of cross-sections, and the following comparison, favour (n,np) and (n,nα) reactions on C, N, and O nuclei, by neutrons of 10 to 30 Mev.: such stars were observed with neutrons of 14 Mev., and of 20-40 Mev., with comparable energy release and angular distribution. However if this interpretation is correct, many more C12$\rightarrow 3\alpha$ stars should be observed in the cosmic plates.

55. Horizontal Cosmic Ray Particles at Sea Level. By D. Jakeman. Presented by D. C. Rose, F.R.S.C.

Events selected by coincident pulses from Geiger counters placed in shielded trays are shown to arise from extensive air showers and from particles travelling in the nearly horizontal direction. A hodoscope system of counters enables the two types of events to be distinguished and provides information regarding the horizontal particles. It is shown that the secondaries associated with these particles trigger the counters and that in general the particles do not pass within the solid angle defined by them. For this reason it is difficult to obtain the absolute rate of particles in the horizontal direction which is of interest in connection with the competitive processes of π meson interaction and decay in the atmosphere. The reason why so many recorded particles have associated secondaries is not clear and this point is being investigated further.

56. On the Variations of Intensity of Cosmic Rays at Ottawa. By John Katzman. Presented by D. C. Rose, F.R.S.C.

Three approximately identical triple-coincidence telescopes with 33 cm. of lead absorber are mounted on a rotating table. The table is supported by a sturdy iron frame. Two of the telescopes can be rotated from the verticle to study asymmetrics and with the third telescope always vertical the zenithal distribution can be studied. The table rotates back and forth through 180° every four hours. The asymmetry at 70° to the zenith is 0.019 ± 0.007 for the south-north and 0.017 ± 0.008 for the west-east direction. The value at 70° for n in the $\cos^n \theta$ relation is 1.98 ± 0.01 for the east-west direction (450 Mev. mesons), in the north-south direction $n = 1.97 \pm 0.01$ (450 Mev. mesons) and $n = 2.05 \pm 0.015$ (250 Mev. mesons).

57. Studies on the δ-Ray Method for Particle Identification in Photographic Emulsions. By N. L. Allen and L. Voyvodic. Presented by D. C. Rose, F.R.S.C.

While extensive use is made of δ-rays for determining the charge of heavy cosmic ray particles recorded in emulsions, there is some confusion over the results obtained by different observers using this method. Part of the confusion arises from the adoption of different criteria for recognizing tracks as δ-rays, and for fixing their energy limits. In an attempt to resolve these difficulties, a series of systematic measurements has been carried out on the δ-ray densities of known particles in Ilford G5 emulsion, using various counting conventions. Comparison with the theoretically predicted densities as given by the Rutherford formula, and efficiency of counting δ-rays under the various conditions, will be discussed.

58. Variations in the Intensity of the Neutron Component of Cosmic Rays. By D. C. Rose, F.R.S.C.

The large geomagnetic effect for the neutron component of cosmic rays shows that

neutrons at sea level must come from primary rays of low energy, that is, of the order of a few Bev. It would, therefore, be expected that variations in intensity associated with solar disturbances, if they exist, would show up more prominently in the neutron component than in the other components of cosmic rays.

The neutron intensity has been observed continuously at Ottawa for over a year and a six-month period has been analysed in detail. The variation in intensity with barometer shows a high correlation, high enough in fact to suggest it is the only variable involved. However, when barometer corrections are made, significant changes in intensity remain which seem related to weather although not in any definite way. It can be shown that these variations may well obscure phenomena which might show a repetition with the rotation of the sun. A seasonal and a diurnal variation are also indicated by the results of these measurements.

59. Ionization Chamber Measurements of Cobalt^{60} Radiation. By D. V. Cormack and H. E. Johns, F.R.S.C. (By title.)

The radiation from a 1000 curie source of Co^{60} has been measured using extrapolation chambers with walls of carbon, aluminum, copper, silver, and lead. The ionization current is found to be independent of the size of air volume of the chamber for dimensions less than 5 mm. The variation of ionization current with front-wall thickness of the chamber has been investigated. A theoretical investigation of the dependence of ion current on the atomic number of the chamber walls has been carried out and a formula similar to Gray's $J_v = E_v/W\rho$ is derived. A method by which an average value of the stopping power ratio ρ may be calculated for a given radiation is given. Calculated values for the ratios of the ionization currents in chambers of various atomic number materials were compared with the ratios determined experimentally. The ratios of the currents in chambers of aluminum, copper, silver, and lead to the current in a carbon chamber are respectively: Experimental, 1.085, 1.262, 1.467, 2.110; Theoretical, 1.100, 1.241, 1.402, 2.07. The differences between the two sets of values are believed largely due to uncertainties in the quantities used to calculate the theoretical stopping powers for electrons.

60. Compton Electron Suppression in the Gamma-Ray Spectra of Co^{60}, Ta^{182}, and Ra(B + C). By R. M. Pearce and K. C. Mann. Presented by G. M. Shrum, F.R.S.C. (By title.)

An anti-coincidence method of suppression of the Compton electron background found in photoelectron spectra has been developed and used with a thin-lens beta spectrometer to investigate the gamma-rays of Co^{60}, Ta^{182}, and Ra (B + C). Suppression is better than 80 per cent successful in the maximum of the Compton electron distribution. A previously unreported 1.01 Mev. gamma-ray has been found in Ta^{182}; no new transitions were found in Co^{60}; the spectrum of Ra(B + C) now shows several of the transitions reported by Latyshev and co-workers in addition to those found by Ellis. Detailed results will be published shortly.

61. The Decay Scheme of Antimony 124. By K. C. Mann and R. M. Pearce. Presented by G. M. Shrum, F.R.S.C. (By title.)

An anti-coincidence technique for Compton electron suppression has been applied to the spectrometer gamma-ray spectrum of Sb^{124}, using a high specific activity source. The following gamma-ray transitions were found: 0.607 Mev. (K,L), 0.658 Mev. (K,L), 0.713 Mev. (K,L), 0.840 Mev. (K) (previously unreported), 1.720 Mev.

(K,L) and 2.03 Mev. (Compton end-point). In addition the primary beta spectrum was carefully run with low statistical uncertainty and at small energy intervals. A Kurie analysis revealed the following beta groups: 2.295 Mev., 1.585 Mev. (both first forbidden), 0.925 Mev., 0.745 Mev., 0.582 Mev., 0.360 Mev. (all allowed). Conversion electron lines of the 0.607 and 0.713 Mev. transitions (both K and L) appear. A self-consistent decay scheme is possible with these results.

62. The Photo-Alpha Reaction in Ne^{20}. By K. L. Erdman and C. A. Barnes. Presented by G. M. Shrum, F.R.S.C. (By title.)

Irradiation of a gridded ionization chamber filled to a pressure of 6 atmospheres with neon gas, by gamma-rays produced in the proton bombardment of Li, yielded several particle groups which have been tentatively assigned to the (γ,α) reaction in Neon. The gamma-ray flux was determined absolutely from computed efficiency for pair production in a large NaI (Tl) crystal. The cross-sections for the transitions to the ground state of O^{16} for the 17.6 and 14.8 Mev. gamma-rays were about 3×10^{-30} cm^2 and 2×10^{-29} cm^2 respectively, and for transitions to the 6 and 7 Mev. excited states of O^{16} for the 17.6 Mev. gamma-ray were about 10^{-28} cm^2. There was also evidence for transitions to these levels in the case of the 14.8 Mev. radiation.

63. Angular Distributions of the $N^{15}(p,\alpha\gamma)C^{12}$ Reaction. By G. C. Neilson, D. B. James, and C. A. Barnes. Presented by G. M. Shrum, F.R.S.C. (By title.)

The angular distribution of the γ-rays from the reaction N^{15} $(p,\alpha\gamma)C^{12}$ has been measured and the spins and parities of the excited states of O^{16} for the 429, 898, and 1210 kev. resonances found to be 2 odd, 2 odd, and 3 odd or 4 even respectively (Can. J. Phys., 30, 1952:717). The only value of the spin and parity of the first excited state of C^{12} consistent with this scheme is 2 even.

The angular distribution of the alpha-particles from the reaction $N^{15}(p,\alpha)C^{12}$ is under investigation in order to assign spins and parities to two further levels in O^{16}.

64. The Disintegration of Neon by Fast Neutrons. By F. C. Flack and J. B. Warren. Presented by G. M. Shrum, F.R.S.C. (By title.)

A gridded ionization chamber filled with neon at 6 atmospheres pressure has been irradiated with fast monokinetic neutrons and the pulse amplitude spectrum analysed using polonium alphas as reference. At neutron energies above 3 Mev. two groups were found corresponding to $Ne^{20}(n,\alpha)O^{17}$, $Q = +0.70$ Mev. ± 0.02, and to $Ne^{20}(n,\alpha)O^{17*}$, $Q = -1.57$ Mev. ± 0.02. The excitation function for the two reactions show several peaks corresponding to energy levels in Ne^{21} at 10.61, 10.84, 11.08, 11.24, 11.48, 11.61, 11.66, 11.80, 11.88, 11.96, 12.03, 12.14, 12.20, 12.25, and 12.36 Mev., assuming the binding energy of the neutron to Ne^{20} to be 7.52 Mev. above the ground state of Ne^{21}. The cross-section at 3.26 Mev. neutron energy was estimated as 30 millibarns. This reaction has some merit for measuring neutron energies.

65. The Stabilization of the Van de Graaff Generator at the University of British Columbia. By J. B. Warren and D. Aaronson. Presented by G. M. Shrum. (By title.)

For two years the University's generator has provided resolved proton beams up to 50 μa., at energies up to 2 Mv., without an intermediate shield. Energy resolution is accomplished by a 90° resolving magnet the field of which is stable to 3 parts, in 10,000 over long periods with current control, and with nuclear magnetic resonance remains constant to a few parts in 100,000. With a beam the generator voltage fluctuates some 5 per cent, which is reduced to ± 1 per cent by stabilization of the spray current. Reverse electron beam control using "sniffer" plates to sniff the atomic ion beam itself, a few inches in front of the target, reduces this to 0.1 per cent. As the beam tries to wander owing to a generator voltage fluctuation, one of the plates notices the motion and, via a differential amplifier system, the reverse electron beam loading on the generator changes so as to nullify the fluctuation.

This system holds the beam on over a period of hours. Using a narrow slit system and about ¼ μa. beam it proved possible to control the beam energy, by varying the nuclear induction oscillator frequency, in steps of 300 ev. in a test run over a fluorine resonance.

66. Performance of a Single Crystal Scintillation Spectrometer. By R. E. Azuma and J. B. Warren. Presented by G. M. Shrum, F.R.S.C. (By title.)

The γ-ray spectrometer consists of a NaI crystal mounted on an E.M.I. 6262 photomultiplier which feeds a linear ratemeter via a single channel kicksorter, the baseline of which can be driven by a clock. The ratemeter output is registered on a Brown recorder which automatically plots out the spectrum. Careful attention to crystal mounting has enabled a resolution (total peak width at half amplitude to peak energy) of 7 per cent to be achieved at energies from 1 to 3 Mev. Over-all stability is better than 1 per cent and linearity is excellent. With a crystal disc ½″ thick low-energy spectra in the region of 10 kev. have been measured.

Gamma radiations from Co^{60}, Zn^{65}, Na^{22}, Na^{24}, RaD, Eu^{155}, and $Eu^{152} + Eu^{154}$ have been examined and compared to calculated spectral distributions for various crystal sizes.

67. Pulse Spectrum from Irradiation of BF_3 Counters with Fast Neutrons. By D. B. James and W. Kulbelka. Presented by G. M. Shrum, F.R.S.C. (By title.)

Two BF_3 long counters, one enriched (96 per cent B^{10}) and one unenriched, both at 60 cm. pressure, were bombarded with neutrons of different energies in the region of 4.5 Mev. The disintegration spectrum was analysed with an 18-channel pulse analyser. Six groups were found. The first two of these were identified as $B^{10}(n,\alpha)Li^{7*}$ ($Q_1 = 2.32$ Mev.) and $B^{10}(n,\alpha)Li^7$ ($Q_2 = 2.80$ Mev.), due to scattered thermal neutrons. Assuming that the other four groups were due to fast neutrons, their Q-values were $Q = 2.30 \pm 0.1$, $Q = 2.80 \pm 0.1$, $Q = 0.49 \pm 0.1$, and $Q = -0.64 \pm 0.1$. The $Q = 2.3$ and $Q = 2.8$ Mev. groups correspond to $B^{10}(n,\alpha)Li^7$ and $B^{10}(n,\alpha)Li^7$ respectively. From a comparison of the distribution of the enriched and the unenriched the $Q = 0.49$ Mev. group arises from some B^{10} reaction, such as $B^{10}(n,p)Be^{10}$ or $B^{10}(n,t)Be^8$.

68. A Three-Crystal Pair Spectrometer. By G. M. Griffiths and J. B. Warren. Presented by G. M. Shrum, F.R.S.C. (By title.)

To obtain simple pulse-height distributions from a scintillation counter measuring

high-energy gamma-rays from nuclear reactions, a "three-crystal spectrometer" has been used. Two side counters, placed in coincidence, actuate a gate in the output of the centre crystal, when triggered by annihilation radiation from the positron produced and stopped in the centre crystal. Such an arrangement has been used to measure the relative pair production cross-section at gamma energies close to the pair threshold (Proc. Phys. Soc., A65, 1952:1050). It is now being applied to the study of high-energy gamma-rays including the 20 Mev. radiation from the $H^3(p,\alpha)$ He^4 reaction.

69. Measurement of Primary Specific Ionization of Fast Electrons. By J. T. Sample and J. B. Warren. Presented by G. M. Shrum, F.R.S.C. (By title.)

The efficiency of a Geiger counter is a simple function of the primary specific ionization "s" of the gas, the pressure, and the path length.

Counters of low efficiency with reasonable plateaus were made by using helium as principal constituent. With thin windows on opposite sides of the counter, efficiencies were determined for monokinetic electrons by the coincidence technique.

The variation of "s" with electron energy between 0.2 and 1.2 Mev. has been obtained, and "s" for negatrons and positrons of the same energy was found to be the same within 1 per cent. Values of "s" found for electrons at the energy of minimum ionization are:

Helium	Neon	Argon	Ethylene	Ethyl alcohol
5.5 ± 0.1	11.6 ± 0.4	29.8 ± 1.5	40.1 ± 1.5	61.5 ± 1.5

70. Fast Coincidence Circuits for the Determination of Nuclear Excited-State Lifetimes. By I. K. McKenzie. Presented by G. M. Shrum, F.R.S.C. (By title.)

A modified Bell and Petch circuit has been built and is now undergoing performance tests. The delay element consists of a slotted 90-ohm coaxial cable. Type 1P21 photomultipliers are used with a stilbene crystal for γ–γ coincidences. The greatest problem encountered was that of stability, in many cases caused by temperature-sensitive circuit components. This has been largely overcome. Lifetimes $\backsim 10^{-11}$ sec. appear to be measurable with this equipment.

71. On Improvement of the Resolution and Transmission of a Thin-Lens Beta-Ray Spectrometer. By J. A. L. Thomson and K. C. Mann. Presented by G. M. Shrum, F.R.S.C. (By title.)

Experiments are in progress on the improvement of the resolution and transmission (per cent solid angle) of a thin-lens spectrometer by the addition of a single iron-free axial dipole. Use is made of the modified ring-focussing properties of the thin lens. Electron collection and detection will take place at the ring focus when use is made of a stilbene phosphor ring and photomultiplier detection. The optimum conditions have been determined by ray-tracing techniques using a light current-carrying wire and by an electron gun and fluorescent screen. The preliminary results are very encouraging.

2.00 p.m.—SUB-SECTION GENERAL PHYSICS, Room 212, Arts Building. PAPERS 72-84.

72. Radio Reflections from Aurora. By P. A. Forsyth and B. W. Currie, F.R.S.C.

Radio echoes from auroral forms with some ray structure are observed with frequencies of 106 and 56 Mc/sec. The 56 Mc/sec echoes occur more frequently than the 106 Mc/sec echoes. Analysis of the observations indicates that the echoes originate from a threshold process, presumably from centres in the auroral forms with electron densities sufficiently high to cause critical reflection. Failure to observe echoes at elevations greater than 15° is attributed to absorption of the radio waves in an ionized layer that forms by horizontal diffusion from the centres of high ionization at the base of the displays.

73. Radio Noise from Aurora. By R. Chapman and B. W. Currie, F.R.S.C.

A further investigation of the 10 cm. radio noise from aurora, observed by Forsyth, Petrie, and Currie in 1948 and 1949, indicates that the noise occurs only when the daily relative sunspot-numbers are larger than 120. This result can be explained in terms of the numbers and velocities of the ionizing particles entering the Earth's atmosphere during an auroral display.

74. Long-Term Variations of 10.7 cm. Solar Emission. By A. E. Covington and W. J. Medd. Presented by D. W. R. McKinley, F.R.S.C.

Daily observations of 10.7 cm. solar noise made at the National Research Laboratories now extend over six years. Since this period commences at a time of maximum sunspottedness in 1947, and ends at a minimum, extreme conditions of the sunspot cycle are included in the examination of radio noise vs. solar activity. A decline in the intensity of the radio emissions from the sunspots and spotless sun is readily apparent, and can be associated with the decline in solar activity as indicated by yearly mean sunspot areas. The equivalent temperature of the spotless sun has decreased from 72,000°K to 40,000°K; this shows that perhaps the sun may be regarded as a variable radio star.

75. The Colour of the Overcast Sky. By W. E. Knowles Middleton, F.R.S.C.

A theory of the spectral radiance of the overcast sky has been developed, and from this function the chromaticity and luminance can be calculated by the usual methods. It is found that the colour of the overcast sky shows a notable dependence on that of the ground beneath, and also depends on the depth and opacity of the cloud layer.

76. The Omegatron as an Analytical Mass Spectrometer. By P. A. Redhead. Presented by D. W. R. McKinley, F.R.S.C.

The Omegatron, which makes use of the cyclotron resonance of ions in a magnetic field, was first described by Hipper (Phys. Rev., 76, 1949:1877). The design and use of the Omegatron as an analytic mass spectrometer will be described. The simplicity

and compactness of the Omegatron allow its application to problems for which a conventional mass spectrometer would be unsuitable. The use of the Omegatron to study evolved gases in sealed-off systems will be described.

77. The Design of Waveguide Filters. By D. Darling. Presented by Raymond C. Dearle, F.R.S.C.

The design of narrow-band waveguide filters, embodying rectangular cavities with inductive coupling irises, has been studied with emphasis on the effect of finite thickness of the iris. Because of the high susceptances involved (of the order of $-j10$ to $-j20$, standard measuring techniques are not suitable, but susceptance and electrical length of the iris can be determined approximately from the bandwidth of the cavity, and the loss at resonance. Experimental results agree reasonably well with the theory developed by Marcuvitz.

78. Effect of Radio Frequency Matching on Converter Crystal Parameters Measured at S-Band. By Raymond C. Dearle, F.R.S.C., J. E. Lokken, and E. H. Tull.

A theoretical expression for noise–temperature ratio as a function of mixer matching conditions has been obtained and compared with experiment. Measurements were made in a conventional heterodyne circuit with a simplified Roberts line for matching the crystal to the i.f. amplifier. All crystal parameters are shown to be affected by the degree of r.f. mismatch to the mixer, but the indications are not in all cases clear cut. Confirmation is obtained for the prediction that i.f. admittance is the dominant factor in determining noise–temperature ratio of a crystal.

79. Diffraction of Microwaves by Cylindrical Objects. By S. T. Wiles and A. B. McLay, F.R.S.C.

Diffraction patterns of a brass tube and a hard rubber rod, each a cylinder of 1 cm. diameter, in a near-plane beam of square-wave modulated 3 cm. waves, with electric vector parallel to the cylinder axis, have been measured in several planes transverse to the incident beam propagation direction. Experimental results for the conducting cylinder agree closely with calculations based on scalar diffraction theory.

Patterns of the dielectric rod show a pronounced central peak immediately behind it and other intensity effects differing from the conducting cylinder patterns, particularly in the vicinity of the shadow.

80. Accuracy of Thickness Determination of Irregularly Shaped Particles by Shadow-Casting Methods. By H. H. Watson. Presented by G. O. Langstroth, F.R.S.C.

It has been stated that when particles are shadow-cast, the elevation (thickness) can be determined with considerable accuracy from the shadow length. This is not generally so, for two reasons: (i) the peak may not be in a position to throw the longest shadow; (ii) the plan position of the peak is not known, and consequently neither is the position of the base line from which the shadow length is measured. The problem has been investigated on a macroscopic scale and measures have been made of the errors involved.

81. Stark Modulated Microwave Spectroscope. By J. F. Mathison. Presented by J. S. Foster, F.R.S.C.

Construction of a (7.5-9) mm. Hughes-Wilson type microwave spectroscope will

be described. Major electronic components have been completed. Such an instrument is capable of a sensitivity of 10^{-8} cm^{-1}. After detection the absorption-line signal will be amplified for visual presentation by means of a low noise input pre-amplifier. The Stark voltage is a 100 kc/sec zero-based square wave continuously variable from (0-750) volts, and with rise-and-fall times of 0.1 and 0.15 μsec., respectively. Frequency of absorption lines may be measured to within $\pm$ 0.1 mc/sec by comparison with a secondary frequency standard zero-beating against a standard frequency transmission from WWV.

82. Internal Waves in British Columbia Inlets. By G. L. Pickard. Presented by G. M. Volkoff, F.R.S.C. (By title.)

Observations at anchor stations in Bute Inlet reveal vertical oscillations of as much as 70 ft. in the isotherms between 150 and 450 ft. depth. The phase correlation between these oscillations and the surface tide is usually good but the amplitude correlation is not consistent. In Knight Inlet progressive internal waves up to 26 ft. in height have been observed in the boundary between the brackish surface water and the deeper saline water. This boundary (depth 15-30 ft.) is a region of marked velocity shear at times and the internal waves are attributed to instability in the flow under these circumstances.

83. A Note on Black Body Radiation. By A. M. Crooker and W. L. Ross. Presented by G. M. Shrum, F.R.S.C. (By title.)

Following a suggestion by Czerny, we write a generalized radiation function in the form $F(\lambda,T) = \lambda^{-m}\,[\exp C2/\lambda T - 1]^{-1}$ where m may be 2, 3, 4, 5 in cases of practical importance. By plotting log F against log λ at a given temperature one obtains a relation which maintains the same form as the temperature is changed. This transformation of Planck's law, and related radiation functions, is very convenient in making radiation calculation. We use this transformation to comment on the specification of a detector required to detect a minimum temperature differential in a black body radiator.

84. The Phase Dependence of Infra-red Absorption Frequencies. By W. L. Ross and A. M. Crooker. Presented by G. M. Shrum, F.R.S.C. (By title.)

Measurements of the frequency shifts on passing from the vapour phase to the solution phase have been made for HCl, HBr, and CO. These measurements have been made at the fundamental and first overtone in a series of non-polar solvents. The shifts, which are always to lower frequencies, can be correlated with the electrostatic interaction of an anharmonic oscillator and the surrounding dielectric medium. The calculated shift is a function of the spectroscopic constants of the molecule, its dipole moment, and the dielectric constant of the solvent.

2:00 p.m.—SUB-SECTION CHEMISTRY, Room 221, Arts Building. PAPERS 85-96.

85. Synthesis of Organic Deuterium Compounds. VIII. The Preparation of 1-Chloro-1-Alkynes. By L. C. Leitch and A. T. Morse. Presented by Léo Marion, F.R.S.C.

The methods previously reported for the synthesis of 1-chloro-1-alkynes were found unsatisfactory for the preparation of 1-chloro-1-propyne and the corresponding

deuterated compound. In the present work, these compounds were prepared for the first time by the dyhydrohalogenation of *cis*-1, 2-dichloro-1-propene and its deuterated analogue. The synthesis was also extended to some homologues of propyne, viz., 1-butyne and 1-pentyne.

86. Some Demethylated Metameconine. By J. A. McRae, F.R.S.C. R. Y. Moir, and A. L. Promislow.

Metameconine (4, 5-dimethoxyphthalide) has only two vacant positions on the benzene ring, yet three "monobromometameconines" have been described, viz., 6-bromometameconine (m.p. 207°), 3-bromometameconine (m.p. 180°) and a compound made by Ray and Robinson from 2-bromoveratric acid and formaldehyde (m.p. 223°), thought by them to be 6-bromometameconine. Further examination of this compound of m.p. 223° now shows that it is in all probability 4-methoxy-5-hydroxy-6-bromophthalide. Similarly, 2-chloroveratric acid and formaldehyde give a demethylated product, probably 4-hydroxy-5-methoxy-6 chlorophthalide, and 3-bromoveratric acid gives both 3-bromometameconine and the 5-demethylated analogue.

87. Some Ethers of Metameconine. By J. A. McRae, F.R.S.C., R. Y. Moir, and J. J. Ursprung.

The Ullmann synthesis using copper powder, 6-iodometameconine, and potassium hydroxide, potassium methylate, or potassium ethylate, gave excellent yields of 6-hydroxymetameconine and its methyl and ethyl ethers, respectively. The reaction failed when applied to 6-iodometameconine and potassium phenolates. Instead, two side reactions occurred: transmethylation and dehalogenation. However, the synthesis of diphenyl ethers from quaternary pyridinium compounds recently introduced by Borrows *et al* in the thyroxine series was found to succeed in the present series as well, and good yields of the following highly hindered diphenyl ethers were obtained from 6-hydroxymetameconine and the appropriate pyridinium compound: 6-(2, 4-dinitrophenoxy)-metameconine; 6-(2, 6-dinitro-4 carbomethoxyphenoxy)-metameconine; and 6-(2-nitro-4-carbomethoxyphenoxy)-metameconine. It was not usually necessary to isolate the intermediate pyridinium compound and it may be said that the method is of considerable promise as a synthetical method because of its ease, smoothness, and comparatively high yields.

88. Fractionation of the Sulfur Isotopes in the Carbonyl-Bisulfite Addition Reaction as Evidence for the Structure of the Addition Product. By W. A. Sheppard and A. N. Bourns. Presented by H. G. Thode, F.R.S.C.

The equilibrium constants for the isotopic exchange reaction between bisulfite ion and carbonyl-bisulfite addition compounds,

$$HS^{34}O_3^- + R{-}\underset{\displaystyle R'}{\overset{\displaystyle OH}{\underset{|}{\overset{|}{C}}}}{-}S^{32}O_3^- \rightleftharpoons HS^{32}O_3^- + R{-}\underset{\displaystyle R'}{\overset{\displaystyle OH}{\underset{|}{\overset{|}{C}}}}{-}S^{34}O_3^-,$$

have been determined for seven aldehydes and ketones. At 25°C. values ranging from 1.021 for acetone to 1.012 for 2-heptanone have been observed. Since exchange

constants of this magnitude are to be expected only if the bonding of the sulfur atom is different in the bisulfite ion and the addition products, these results are considered to confirm the carbon—sulfur bond structure for carbonyl-bisulfite addition compounds.

89. The Influence of Surface Area on the Rate of Oxidation of Iron at High Temperatures in Oxygen. By E. J. Caule and M. Cohen. Presented by I. E. Puddington, F.R.S.C.

The process of oxide film formation on pure iron has been studied by the method of continuous weighing at temperatures of about 370°C. and oxygen pressures of about 3 cm. of mercury, with a microbalance capable of weighing in a vacuum. The effect on subsequent oxidation rates of several oxidations and reductions on the same sample has been noted and explained as due to roughening of the surface. Support for this explanation has been obtained from electron microscope pictures of iron surfaces subjected to various oxidation and reduction procedures. On iron prepared by electropolishing an oxide film has been detected and measured even before high temperature treatment.

90. Orbital Valence Theory and Inorganic Structure. By W. R. Trost. Presented by C. C. Coffin, F.R.S.C.

The valence (the ns, np, $(n-1)d$, $(n-2)f$) and the outer orbitals (the $(n+1)s$, $(n+1)p$, nd, $(n-1)f$) of the elements, in their combinations with the halogen orbitals, provide a model for the explanation of the properties of the halides of the elements if all orbitals are counted. As the valence of the non-halogen element increases in each period, the element passes through three distinct relationships with the halogen. In the model, the three kinds of elements form halides that correspond, with some dependence on the halogen, to the ionic, then chain and layer, and finally the molecular solid forms of the halides. The structures of the solids depend only on the orbital configurations of the atoms in the compound; variations in volatility in solid and liquid are also directly related to the atomic orbitals.

91. A Chemical Study of the Peats of Quebec. IV. Compostion of the Peat from the Rivière-du-Loup Peat Bog. By C. E. Brunette, D. Spence and J. Risi. Presented by Paul E. Gagnon, F.R.S.C.

The reserves of peat in the province of Quebec are conservatively estimated at 200,000,000 tons of air-dried material. The short Canadian summer makes difficult the drying of peat, and hence its use as fuel. The use of peat as a chemical raw material therefore seems much more promising.

The Rivière-du-Loup peat bog, near the city of Rivière-du-Loup, contains some 9,500,000 tons of dry peat. A chemical fractionation of a number of samples from this bog was made by a slight modification of S. W. Souci's method. Determined were: pH, by contact with indicator paper; moisture, by drying at 105° for 48 hours; bitumen (waxes and resins), by benzene-alcohol extraction; substances soluble in hot water; hemicelluloses and other substances soluble in 2 per cent hydrochloric acid; cellulose and other substances soluble in 80 per cent sulphuric acid; humic substances by extraction of all other organic ingredients with acetyl bromide; lignin, by difference; total ash; ash insoluble in 80 per cent sulphuric acid, by ignition.

Results on 48 samples show that in the well-humidified area of the bog the con-

tent of bitumen, hemicelluloses and other substances soluble in 2 per cent hydrochloric acid, cellulose and other substances soluble in 80 per cent sulphuric acid, first increases with depth in the top layers, but decreases with depth in the bottom layers. Total ash and ash insoluble in 80 per cent sulphuric acid, humic substances, and lignin generally increase with depth across the whole profile.

An average content of only 7.24 per cent of bitumen does not justify the hope of a profitable extraction of waxes and resins on an industrial scale. However, an average content of 19.8 per cent in total carbohydrate (cellulose and hemicelluloses) shows the economic possibility of their hydrolysis in simple sugars followed by various fermentations of the latter into useful products. Finally, while an average content of 29.38 per cent in humic substances seems remarkably low, that of 16.83 per cent in lignin is unusually high, suggesting the possible conversion of the latter by hydrolysis, pyrolysis, or catalytic hydrogenation into valuable derivatives.

The industrial chemical possibilities of this peat are numerous. A total yield of the following complexes by chemical fractionation could be expected: nearly 700,000 tons of bitumen (waxes and resins); 700,000 tons of substances soluble in hot water (pectines, simple sugars, acids, etc.); 1,900,000 tons of total carbohydrates; 1,600,000 tons of lignin; 2,800,000 tons of humic substances, from which several products of industrial value may be derived.

92. Préparation d'esters de l'α- et de la β-hydroxylaudanosine. Par J.-L. Ferron et P. L'Ecuyer. Présenté par Paul E. Gagnon, F.R.S.C.

L'α- et la β-hydroxylaudanosine isolés par la réduction catalytique du méthochlorure de papaverinol réagissent avec les chlorures d'acides dans la pyridine pour donner les esters correspondants. Le butyrate, le caporate, l'isovalérate, le benzoate et l'acétylsalycilate de l'α- ainsi que le butyarate et le benzoate de la β-hydroxylaudanosine ont été préparés et caractérisés.

93. Synthesis, Potentiometric Titrations, and Absorption Spectra of 4-Alkyl-3-Phenyl- and 1,3-Diphenyl-5-Pyrazolones. By Paul E. Gagnon, F.R.S.C., Jean L. Boivin, and René Paquin.

The ionization constants, the ultra-violet and infra-red absorption spectra of two new series of pyrazolones have been determined and their structures have been established.

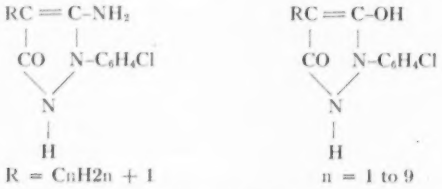
94. Synthesis of 1,4 and 2,4-Diphenyl-3-Amino-5-Pyrazolones. By Paul E. Gagnon, F.R.S.C., Jean L. Boivin, and Méüde Tremblay.

The synthesis of 1,4-diphenyl and 2,4-diphenyl-3-amino-5-pyrazolone was effected. The former was obtained from the phenylhydrazone of ethyl phenyloxalacetate in the presence of an alkaline catalyst, whereas the latter could be formed from the phenylcyanoacetate only with an acidic catalyst.

95. Synthesis of 2-Chlorophenyl-4-Substituted-5-Pyrazolones. By Paul E. Gagnon, F.R.S.C., Jean L. Boivin, and Roderick MacDonald.

By reacting monosubstituted malonates and cyanoacetates with o,m,p-chloro-

phenylhydrazines, the corresponding 2-chlorophenylpyrazolones were obtained in good yields.



96. Ion Exchange on Unstabilized Cellulose Acetate. By Karl Keirstead and John Myers. Presented by Paul E. Gagnon, F.R.S.C.

Evidence, given by Malm, for the ester form of the sulphate in unstabilized cellulose acetate has been expanded by ion exchange studies on precipitated and on fibre cellulose acetate. The equilibrium reached during ion exchange is affected by such factors as the pH and the concentration of the salt solution used (sodium chloride and calcium chloride). Various methods have been used to estimate the equilibrium. Evidence has been found for the conversion of the sulphate ester to the free acid during the process of dissolving the cellulose ester in acetone and the subsequent precipitation. A mechanism is proposed for this conversion. A study has been made of the accuracy of the various analyses involved.

Wednesday, June 3

9:00 a.m.—SUB-SECTION SOLID STATE PHYSICS, Room 212, Arts Building. PAPERS 97-111.

97. Snow Crystal Type Related to Vapour Density. By J. S. Marshall and M. P. Langleben. Presented by A. Norman Shaw, F.R.S.C.

The laboratory experiments of Nakaya and his group on snowflake growth have been analysed in terms of diffusion theory. The crystal type appears to be a function of vapour density excess, the amount by which the prevailing vapour density exceeds the vapour density at the surface of a growing ice crystal. If the vapour density at the edges of a growing crystal is assumed to be greater than that over its flat surfaces, and that at the corners greater still, a simple mechanism can be devised. Support for this mechanism has been obtained from an analogue experiment in an electrolytic tank.

98. Snow Trails and Seeded Showers. By K. L. S. Gunn and A. S. Dennis. Presented by A. Norman Shaw, F.R.S.C.

The pattern of falling snow as observed by radar consists of oblique trails of snow, apparently originating in discrete generating elements of considerable lifetime. Sometimes the snow originates near the frontal surface; otherwise it originates higher up and is greatly intensified at that surface. The observed pattern is not the result of instability; rather, the presence of instability confuses the pattern. Similar snow trails are observed in summer mixed with showers. There is evidence that on occasion they seed the showers, and help determine the pattern of shower distribution.

99. The Tensile Strength of Liquid Nitrogen. By A. D. Misener, F.R.S.C., and F. Hedgcock.

The static tensile strength of liquid nitrogen at temperatures below its boiling point has been measured by a bellows method and found to have a maximum value of 3.4 atm/cm². The discrepancy between this value and the theoretically predicted value of 60 atm/cm² is attributed to the coalescing of minute bubbles trapped in the surface cracks of the container.

100. The Self-Consistent Field for Au^+ and the Scattering Factor for Coherent Radiation. By W. G. Henry. Presented by I. E. Puddington, F.R.S.C.

The self-consistent field for Au^+ has been calculated by the method of D. R. Hartree. The maximum difference between the estimated and calculated Z is 0.015 in the contribution from any one group with the exception of the $5d^{10}$ group for which it is 0.025. The scattering factor has been calculated on the basis of the self-consistent field obtained.

101. Some Aspects of the Phenomenological Theory of Superconductivity. By F. A. Kaempffer and J. A. L. Thomson. Presented by G. M. Volkoff, F.R.S.C.

The ideal superconducting state of a piece of metal is defined as the state in which at the absolute zero of temperature no electromagnetic fields can exist inside the metal. Since the equations of the electromagnetic vacuum state resemble formally the equations of a nonviscous fluid, it is possible to describe the thermodynamical behaviour of the ideal superconductor in the vicinity of the absolute zero of temperature in terms analogous to the hydrodynamical theory of liquid He II as developed by Landau.

102. The Study of Impurities in Superconductors. By H. Preston-Thomas and W. B. Pearson. Presented by G. Herzberg, F.R.S.C.

It has previously been observed that a small amount of dissolved gas can have a profound effect on the superconductive transitions of a "hard" superconductor. Conversely, it has been shown that a thorough degassing of a "hard" superconductor will cause it to exhibit characteristics approaching those of an ideal or "soft" superconductor. In observing this approach to ideality, it is essential that both magnetic and resistive measurements of the specimen be made.

Lead is a material that appears to be a hybrid of the "hard" and "soft" superconductors, behaving like the former at low and like the latter at high magnetic fields. It has been found in this laboratory that its behaviour is greatly affected by its gaseous impurity content and thermal history, and an attempt has been made to correlate these factors so that the superconductive characteristics can be used as a sensitive means of analysing the metallurgical and chemical properties of the lead.

103. Thermoelectricity in the Alkali Metals at Low Temperatures. By D. K. C. MacDonald and W. B. Pearson. Presented by G. Herzberg, F.R.S.C.

The modern theory of electron transport in metals due to Bloch, Wilson, and others leads to the formula:

$$S = -\frac{\pi^2 k^2 T}{3|e|\zeta}\left(1 + \frac{d \log l}{d \log E}\right)$$

for the thermoelectric power, S, in a simple metal (or alloy) at low temperatures. Wilson has stated —

$$\frac{d \log l}{d \log E} = 0$$

for impurities. Since ζ (the chemical potential or Fermi Energy) is necessarily positive, S should always be negative and linear with T at low temperatures and, on Wilson's hypothesis, independent of impurity content.

We have carried out measurements on all the alkali metals, which should in principle present the closest approximation to the theoretical model, continuously over the temperature range $\sim 4°K$ to $\sim 80°K$. In addition to the purest specimens available, a range of alloys (e.g. K-Rb) has been examined.

Serious contradictions with the basic theory are found; for example, the thermoelectric power is positive in Cs and Rb at low temperatures. Apart, however, from the adequacy or otherwise of the fundamental theory, such experiments are furnishing valuable information on electron scattering in metal.

104. A Method of Concentrating He^3-He^4 Mixtures. By K. R. Atkins, J. C. Findlay, D. R. Lovejoy, and W. H. Watson, F.R.S.C.

The method relies upon the fact that liquid He^4 is superfluid, whereas liquid He^3 is not. The dilute mixture is liquefied and the He^4 is allowed to drain away through a small leak, leaving behind a mixture in which the concentration of He^3 steadily increases. In this way the concentration can be raised from 2 per cent to 64 per cent in a single operation. A high rate of processing can be realized.

105. The λ-Transition in Liquid Helium. By K. R. Atkins, M. H. Edwards, and R. A. Stasior. Presented by W. H. Watson, F.R.S.C.

Measurements on liquid helium of the coefficient of thermal expansion and the velocity of sound have provided information concerning the nature of the λ-transition. It seems that Ehrenfest's conception of discontinuities in the second order derivatives of the Gibb's free energy is not as appropriate as Tisza's suggestion that these second order derivatives become infinite at the transition temperature.

106. Theory of the Reverse Saturation Current of Germanium Point Contact Rectifiers. By J. H. Simpson. Presented by D. W. R. McKinley, F.R.S.C.

An expression for the saturation component of the reverse current of high inverse voltage germanium rectifiers is derived on the assumption that this component is due to the motion of positive holes in the p-type inversion layer at the surface of the germanium. Holes diffuse into this layer from the body of the germanium and migrate towards the whisker under the influence of the reverse voltage. It is the rate of this diffusion from the body which limits the magnitude of this component of the current and produces the saturation effect. With a reasonable assumption

concerning the number of holes in the inversion layer, the magnitude of the saturation current and the shape of the curve obtained experimentally can be explained.

107. Anharmonicity in a Linear Chain. By J. S. Dugdale and D. K. C. MacDonald. Presented by G. Herzberg, F.R.S.C.

Since the assumption of harmonic oscillations in a solid cannot account for many important properties of the body (e.g., the thermal expansion, deviations from the Dulong-Petet law at high temperatures, etc.) the influence of anharmonicity on the properties of a linear chain with nearest neighbour interaction has been studied in detail. We assume an interatomic potential of the form:

$$V = \frac{ax^2}{2} - \frac{bx^3}{3} + \frac{cx^4}{4} + \ldots$$

where x is the difference in displacement of neighbouring atoms from their unstrained equilibrium positions at 0°K.

By using classical statistical mechanics and the one-dimensional analogue of the partition function at constant pressure the Gibb's free energy is obtained as a power series in P and T. Hence expressions for the usual thermodynamic properties of the model are derived.

The limitations of the application of this theory to actual solids are discussed.

108. Alternative Solution to the Ehrenfest Problem. By F. G. Hess. Presented by G. M. Volkoff, F.R.S.C. (By title.)

Explicit expressions for the probabilities connected with the well-known Ehrenfest model, which is used to clarify Boltzmann's H theorem, have been obtained by M. Kac (Am. Math. Monthly 54, 1947:369), who has applied the usual method of dealing with problems involving discrete Markov chains. However, the solution to the problem can be obtained in a simpler way if the problem is formulated in terms of a direct product representation. The method should be useful for calculating probabilities connected with discrete Markov chains of similar complexity.

109. Influence of the Paramagnetic Resonance on the Faraday Rotation. By Guy Paquette. Presented by G. M. Volkoff, F.R.S.C. (By title.)

A theory, proposed by Opechowski (Rev. Mod. Phys., Jan., 1953) gives the change of the paramagnetic rotation caused by introducing a high frequency magnetic field perpendicular to the steady magnetic field. To get more detailed information about this change, the theory was applied to the case of $NiSiF_6 6H_2O$, for 90°K, 9°K, and 1.9°K, making reasonable assumptions about the spin-lattice relaxation constant. At 1.9°K, the inversion in sign of the total rotation, for one of the transitions, does not happen at saturation (A. Kastler, Comptes rendus, 232, 1951:953), but for a steady magnetic field of a few hundred gauss.

110. Quantum Theory of Nonviscous Fluids at Low Temperatures. By F. A. Kaempffer and J. E. Lokken. Presented by G. M. Volkoff, F.R.S.C. (By title).

A study is being made of the higher order terms in the Hamiltonian of quantum hydrodynamics as established by Landau. These higher order terms can be inter-

preted as representing interactions between phonons, and have been used successfully by Landau and Khalatinkov to calculate the viscosity of liquid He II below 0.5°K. Other observable effects of the phonon-phonon interaction, especially the contribution to the specific heat, are investigated and the importance of introducing a virtual roton-spectrum in order to make matrix elements finite is stressed.

111. On the Propagation of "Second Shock" in Liquid He II. By F. A. Kaempffer and D. K. Adams. Presented by G. M. Volkoff, F.R.S.C. (By title.)

An investigation is being made of the propagation of second sound of large amplitude in liquid He II. All terms in the phonon distribution up to the order v^2/c^2 are considered, where v is the local velocity of the phonon gas and c the velocity of ordinary sound in the underlying liquid. The properties of the resulting shock wave equations are being studied.

9:00 a.m.—SUB-SECTION NUCLEAR PHYSICS, Room 222, Arts Building. PAPERS 112-124.

112. Hyperfine Structure Studies by the Atomic Beam Magnetic Resonance Method. By Hin Lew. Presented by G. Herzberg, F.R.S.C.

A description will be given of the Atomic Beam Laboratory of the National Research Council and of the general programme that is being carried on. Brief mention will be made of recent work on the hyperfine structures of praseodymium, aluminum, silver, and gold.

113. Mass Spectrographic Determination of the Decay Energies of As^{74}, As^{76}, Pm^{144}, Pm^{148}, Pm^{150}, Eu^{154}, Tb^{160}, and Ho^{164}. By Benjamin G. Hogg and Henry E. Duckworth. Presented by A. B. McLay, F.R.S.C.

Mass spectrographic measurements will be reported of the following mass differences: Se^{74}-Ge^{74}, Se^{76}-Ge^{76}, Nd^{144}-Sm^{144}, Nd^{148}-Sm^{148}, Nd^{150}-Sm^{150}, Gd^{154}-Sm^{154}, and probably also Dy^{160}-Gd^{160} and Er^{164}-Dy^{164}. Comparison with disintegration data will be made where such data are available. These isobaric mass differences will be used to test the validity of the semi-empirical mass formula in the Se-Ge and Nd-Sm mass regions.

114. Photo Neutron and Photo Proton Cross-Sections in Silicon. By L. Katz, F.R.S.C., R. N. H. Haslam, J. Goldemberg, and J. Taylor.

The (γ, p) and (γ, n) cross-sections in Si^{29} and Si^{30} have been measured as a function of photon energy. It was not possible to measure the contribution to the (γ, n) cross-section from each isotope separately; however the combined (γ, p) integrated cross-section for both isotopes is over two times larger than the combined (γ, n) integrated cross-sections, and the cross-section maxima are 6 Mev. apart. This result is rather surprising, since the (γ, p) threshold in each isotope is over 2 Mev. higher than the corresponding (γ, n) threshold. These results may be explained by assuming that the direct interaction between photons and individual protons in the nucleus as postulated by Courant plays a dominant role.

115. A Search for Short-lived States Following Alpha-Decay. By J. S. Fraser and J. C. D. Milton. Presented by L. G. Elliott, F.R.S.C.

A search was made for short γ-ray lifetimes in the states excited by α-decay. The γ-rays were detected by a stilbene cylinder 3 cm. diam. $\times$ 3 cm., the α-particles in a thin stilbene crystal 5 mg/cm^2, and coincidences were taken with a circuit of the type described by Bell, Graham and Petch (Can. J. Phys., 30, 1952:35). The α-emitters Cm^{242}, Am^{241}, Pu^{239}, Pu^{238}, Np^{237}, U^{238}, U^{235}, U^{233}, $RhTh^{228}$, and Ru^{226} were investigated. The theory of Weisskopf (Phys. Rev., 83, 1951:1072) predicts total lifetimes $> 10^{-9}$ sec. for several of the E2 transitions in the even-even nuclei. No such lifetimes were found in any of the nuclides, except the known 63 mμsec. state excited in the decay of Am^{241}. A plausible explanation of the speeding up of E2 transitions is found in the strong coupling theory of Bohr and Mattleson (Phys. Rev., 89, 1953:316).

116. The Nuclear Magnetic Resonance Effect as a Means of Monitoring the Isotopic Purity of Heavy Water. By J. G. Bayly. Presented by L. G. Elliott, F.R.S.C.

A proton nuclear resonance detector is being developed for the measurement of changes in the amount of hydrogen in a flowing sample of high purity D_2O. The signal produced by the protons provides a measure of the hydrogen concentration and is also used to regulate either the magnetic field or the radio frequency oscillator. No paramagnetic ions are added to the heavy water and the effect of a reduced relaxation time is obtained by flowing the water through the proton-detecting coil from a storage volume in the magnetic field.

117. The Yield and Angular Distribution of γ-Rays from $Be^9(p\gamma)B^{10}$. By E. B. Paul and H. E. Gove. Presented by L. G. Elliott, F.R.S.C.

The yield of high energy (approximately 7 Mev.) and 0.72 Mev. γ-rays from this reaction has been studied at proton energies from 0.90 to 1.14 Mev. The angular distribution of the ground state γ-ray at the 1.00 Mev. resonance agrees with previous measurements and indicates a spin for the compound state of $2-$. The individual angular distributions at the 1.08 Mev. resonance of the two γ-rays (6.75 and 0.72 Mev.) in cascade are both isotropic to within 5 per cent which indicates a spin of 0 for this compound state. The low probability at the 1.00 Mev. resonance of the transition to the B^{10} first excited state ($J = 1+$) compared to that leading to the ground state ($J = 3+$) is difficult to explain on the above assignment.

118. Neutron Diffraction by Liquids. By D. G. Henshaw and D. G. Hurst. Presented by H. Carmichael, F.R.S.C.

Scattering of neutrons of wavelength 1.08A by liquid oxygen, nitrogen, and argon has been measured over the angular range 4° to 78°. A procedure well known in x-ray diffraction analysis has been used to transform the results into the atomic density as a function of distance from an atom. Deviations from the mean density fluctuate about zero with an amplitude that decreases somewhat more rapidly than $(\text{distance})^{-2}$. The general form of the molecular structure deduced from x-ray measurements has been confirmed. There are some differences in the details.

119. Electrostatic Interaction and Inelastic Scattering of Charged Particles. By G. K. Horton. Presented by H. Grayson-Smith, F.R.S.C.

Cross-sections for inelastic scattering of charged particles by nuclei, regarded as superpositions of electric multipoles, due to electrostatic interaction, are calculated. By assuming one nuclear excitation level the equations of motion may be reduced to a set of coupled simultaneous differential equations which are solved by a perturbation method. Use has been made of the approximation of geometrical optics (w.k.b. approximation). The general results, depending on the multipole order of the interaction, the energy of the incident charged particles, and the energies and angular momenta of the two nuclear levels involved, are applied to particular transitions in various nuclei.

120. A Nuclear Magnetic Resonance Spectrum Strongly Perturbed by Quadrupole Interaction. By G. Lamarche and G. M. Volkoff, F.R.S.C.

A theoretical investigation is presented of the energy levels of a nucleus of spin $I = 5/2$, a given magnetic moment μ, and electric quadrupole moment eQ, placed in a uniform magnetic field H, and a non-axially symmetric crystalline electrostatic potential ϕ. The dependence of the energy levels, line frequencies, and transition matrix elements on the parameter $R = 4\mu H/eQ\phi_{zz}$ is discussed over the whole range of the parameter $O \leqslant R < \infty$ for certain orientations of the crystal in the magnetic field thus linking up the pure quadrupole with the Zeeman spectrum.

121. On the Equivalence of Different Methods for Calculating Adiabatic Resonance Charge or Excitation Transfer Between Atoms. By J. David Jackson. Presented by J. S. Foster, F.R.S.C.

A comparison is made between two methods for handling charge or excitation transfer processes between atoms moving with small relative velocities and involving no change in internal energy. The method of perturbed stationary states is shown to be equivalent to an impact parameter method due to Kohn. The electron capture by singly charged helium ions passing through helium gas is calculated by Kohn's method for incident ion energies from 200. ev. to 100. kev., and compared with recent experimental data. The general agreement between theory and experiment is good.

122. The Spin and Magnetic Moment of Odd-Odd Nuclei. By G. E. Tauber and Ta-You Wu. Presented by D. C. Rose, F.R.S.C.

In some cases the spin predicted by the nuclear shell model based on extreme j, j coupling does not agree with the empirical value. Among the odd-odd nuclei the most noted exceptions to the model are Li^6 and Na^{22}. It is therefore to be investigated whether the empirical data on the spin and the magnetic moment can be understood by assuming a coupling much closer to L.S. than j, j for the proton and the neutron in the incomplete shell. By solving the secular equation for intermediate coupling, it is found that the correct spin for the lowest state, and the position and spin of the excited states in some cases, can be obtained by choosing the right amount of

spin-orbit interaction, depending on the type of nucleon-nucleon interaction used. Calculations have been carried out for exponential, Yukawa, and Gaussian potential of various "ranges." For each type and a given range, the constants in the potential have been estimated from the empirical data for two free nucleons. The energy levels for the various types of interaction and "ranges" have been calculated as a function of the spin-orbit interaction parameter, whose value is then determined from the known ground and excited states.

The magnetic moments for Li^6, Na^{22}, and other nuclei have also been obtained by constructing the appropriate wave function for intermediate coupling. The agreement with the empirical values for the magnetic moment is found to be good.

123. Theory of Isometric Transitions in Nuclei. By K. Gottfried and P. R. Wallace. Presented by A. Norman Shaw, F.R.S.C.

The lifetimes for isomeric transitions of arbitrary multipole order have been calculated on the one-particle model. An l-selection rule is deduced for magnetic transitions; Δl may not be greater than the multipole order. Magnetic radiation lifetimes are found too short on this model, as had been observed earlier for most electric transitions. This is understandable, since the matrix elements should be drastically reduced owing to readjustment of the wave functions of the core particles caused by the tensor force exerted by the odd (radiating) particle. The bearing of these considerations on the liquid drop model of A. Bohr will be discussed.

124. A New Method of Nuclear Spin Determination. By G. M. Volkoff, F.R.S.C., and N. G. Cranna.

The angular dependence on crystal position of the first and second order shifts of nuclear magnetic resonance lines in a crystal due to quadrupole interaction has been discussed previously. It has now been shown that a comparison of the amplitude R of the second harmonic term in the first order splitting of the inner satellites, and the amplitude U of the fourth harmonic term in the second order shift of the central component leads to the determination of nuclear spin with the aid of

$$(I + \tfrac{3}{2})(I - \tfrac{1}{2}) = 32\nu_0 U/R^2$$

where ν_0 is the unperturbed resonance frequency. The method has been tested by applying it to Al^{27} in spodumene where it yields the known value of $I = 5/2$. The method will be of practical interest in those cases where the total number $2I$ of line components cannot reliably be counted owing to the outer satellites being made too broad and weak by crystal imperfections.

11:30 a.m.—Business Meeting of the Section.

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Light-face figures indicate the number of the article, bold-face figures the number of the page.

SECTION IV.—GEOLOGICAL SCIENCES

Monday, June 1

11.00 a.m.—Meeting of the Section—Room 2, Science Building. (In the absence of the president, Dr. George Hanson, F.R.S.C., who is away in New Zealand, no Presidential Address will be given.)

1. On the Relationship between Physical and Geological Studies of the Earth. By J. T. Wilson, F.R.S.C.

The earth is a heat engine. As such it operates by some fundamental earth process according to established laws of physics. The study of the primary manifestations of the process at the present time, including heat flow and earthquakes, constitutes much of physics of the earth. Volcanism, changes of level, erosion, sedimentation, granitization, and ore deposition are presumably other consequences.

Geology is the study of the past history of this process.

Soon it should be possible to define the process precisely. Already it would seem in order to combine studies of the process and of its history.

2.00 p.m.—Meeting of the Section.

2. Some Aspects of the Cooling of the Earth. By J. A. Jacobs. Presented by J. T. Wilson, F.R.S.C.

The composition of the earth's core is reviewed and a physical explanation is offered as to how the earth's inner core may have become solid. The question of convection currents in the earth's core is examined and it is estimated that convection can occur if the radioactive content of the inner core is only about 2 per cent of that in the crust. Finally it is shown that conduction alone will probably suffice to transfer the heat from the core through the surrounding mantle.

3. On Grabens, Rifts, Major Wrench Faults and Straight Island Chains. By J. T. Wilson, F.R.S.C.

The above features have in common large size, traces which are straight either as a whole or in segments, and occasional to frequent volcanism. All properties including the irregular vertical motions which would cause grabens and horsts appear to follow from E. M. Anderson's explanation of wrench (transcurrent or strike-slip) faults.

These large features are more numerous than was formerly supposed. They can be classified according to their location relative to related ranges. Reasons why horizontal movements have occurred can be given in many cases. At least eight large examples occur in Canada, two in British Columbia, five in the Shield, and one in the Maritimes.

4. An Analysis of Downpunching. By H. S. Heaps. Presented by G. Vibert Douglas, F.R.S.C.

A theoretical analysis has been made of the stresses produced in the outer crust of the earth by the weight of a cylindrical load on its upper surface. Isostatic compensa-

tion was taken into account. Some of the results of this study are presented as applicable to a portion of the crust supporting an ice-cap. It is found that the assumption of a perfectly elastic granite crust, of thickness 20 km., supported by a fluid-like material of density 1 gm. per cu. cm. greater than that of the crust, leads to the conclusion that a loading of 100 kgm. per sq. cm. over an area of radius 200 km. will be just sufficient to cause a downpunching shear to commence at the lower surface. This assumes that the stresses producing shear are due entirely to the surface loading. The modification of this result when previously existing stresses are taken into account is discussed, as is the effect of a different size and profile for the ice-cap.

Certain of the results are quite sensitive to the density of the material directly below the crust, but this density appears to be closely related to features which might be observed in the geography of the surrounding area.

5. A Geological Interpretation of Structural Data from Aerial Photographs of Southeastern Ontario. By Angela Burlinson. Presented by J. T. Wilson, F.R.S.C.

The structural data obtained from an examination of aerial photographs for southeastern Ontario (between Kingston and Lake Nipissing) are discussed. These data have been correlated with ground observations and a close similarity has been found in the results from both methods. Special studies of foliation patterns have been made of the Cheddar-Anstruther batholith and of the fault system in the Renfrew area. A western extension of these faults has been recognized en echelon along the Lake Timiskaming–Ottawa River valley.

6. The Structural History of the Porcupine Gold Area. By E. S. Moore, F.R.S.C.

Thirty months have been spent in recent years in a study of the Porcupine Area with the preparation of a new geological map on a scale of 1 inch equals 1000 feet. This study has revealed a number of new faults and evidence of several periods of folding and igneous activity, and has made it possible to present a more complete history of structural features than was formerly available.

7. Some Glacial Features between the Mackenzie River and Hudson Bay from Air Photographs. By Mary J. Downie, Anita G. Evans, and J. T. Wilson, F.R.S.C.

Eskers, direction of drumlins, and some beaches have been plotted for much of Keewatin and eastern Mackenzie Districts. The directions of eskers, drumlins, and published striae parallel one another. South of a disturbed zone between Eskimo Point and Coppermine the directions fan out to south and west. Farther north the flow, probably owing to another ice sheet, swept more uniformly from Hudson Bay to the Arctic Coast.

Near the Mackenzie River the junction with Cordilleran ice caused an abrupt change in direction to northwest. This flow apparently formed a huge terminal moraine immediately east of the Mackenzie Delta.

Tuesday, June 2

9.00 a.m.—Meeting of the Section.

8. Glacial Features of Ungava from Air Photographs. By Mary C. V. Douglas and R. N. Drummond. Presented by J. T. Wilson, F.R.S.C.

Air photographs of the Ungava Pensinsula of Quebec and Labrador north of the Gulf of St. Lawrence and latitude 50°N have been examined and an interpretation of some of the geological features has been plotted on 32 map sheets on 8 miles to 1 inch scale. A map on reduced scale and some photographs showing the types of glacial features observed are here presented. Numerous drumlins show the pattern of latest glaciation but it does not appear to radiate from any one centre. Many large eskers parallel the drumlins. Some raised marine beaches have been plotted.

9. The Branching Ratio of Potassium-40 and a Possible Method for Determining Geological Ages. By R. D. Russell, H. A. Shillibeer, and A. K. Mousuf. Presented by J. T. Wilson, F.R.S.C.

The β-decay rate of K^{40} is now well established, but the branching ratio is still unknown. To obtain a value for this, fifteen potassium minerals have been analysed for potassium and radiogenic argon. Five of these which came from pegmatites dated by uranium minerals give 6.0 ± 1.0 K-electron captures per 100 β-emissions. Results from different potassium minerals and minerals differing greatly in age agreed. This is strong evidence against any loss of argon. Further work may justify this analysis as a method for determining the ages of potassium minerals.

10. On the Formation of Pillow Lavas and Breccias. By J. F. Henderson, F.R.S.C.

Pillow lavas make up a substantial part of the greenstone belts of the Canadian Precambrian Shield. Associated with them, commonly in minor amount, are volcanic breccias. In the Yellowknife greenstone belt, Northwest Territories, many of the breccias are composed of small fragments of lava that contain, scattered through them, larger ovoid fragments with fine-grained margins, amygdules, and other characteristics of pillows. These breccias grade into typical pillow lava; their common origin seems apparent.

Comparison is made with the "basalt globe breccias" and "globular basalts" of Iceland which have been shown by Noe-Nygaard to have a common origin and to have formed by extrusion in water. It is concluded that Precambrian pillow lavas are likewise a type of breccia extruded in water, and that the pillows were formed by coagulation of the lava into globules that were deposited as entities.

11. The Pre-Timiskaming Unconformity in the Rouyn-Beauchastel Area, Western Quebec. By M. E. Wilson, F.R.S.C.

The Timiskaming sediments of the Rouyn-Beauchastel map-areas occur in an east-west trending belt continuous with similar rocks occurring to the west in the Kirkland Lake–Larder Lake district in Ontario and to the eastward in Joannès to Malartic townships, Quebec. They are adjoined on the north by the volcanic rocks of the (Keewatin) Abitibi series and on the south by the mica schist and interbedded lavas and pyroclastics of the Pontiac group. Their relationship shows that the rocks

of both the Abitibi series and the Pontiac group were highly folded before the Timiskaming was laid down. The evidence for this unconformity will be described and the relationship of the Pontiac to the Abitibi briefly discussed.

12. Secondary Minerals from Montmagny and Bellechasse Counties, Quebec. By Carl Faessler, F.R.S.C.

Deposits of nickel and gold in Montmagny-Bellechasse area show the extensive oxidation of the surface material characteristic of many parts of the Appalachian region in Quebec. Among the secondary minerals are: hisingerite, allophane, lutecite, and cyanotrichite.

13. Origin and Structure of the Pyritic Ore Bodies of Algoma East of Goudreau. By G. Vibert Douglas, F.R.S.C.

The pyritic ores of this area are believed to be of hydrothermal origin. They represent the mineralization by hydrothermal solutions of the sheared and brecciated incompetent layer lying between the competent acid volcanic footwall and the basic volcanic hangingwall. Evidence for these relationships is to be found in the origin of the ottrelite schist of the footwall and in the shearing and veining of the hangingwall. These events preceded the emplacement of the Algoma granite from which the mineralizing solutions are believed to come.

14. The Origin of the Nova Scotian Gypsum and Anhydrite Deposits. By Nordau R. Goodman. Presented by G. Vibert Douglas, F.R.S.C.

Field evidence available from the extensive exposures of Lower Carboniferous calcium sulphate beds and microscope examination of collected specimens indicate the following origin: the calcium sulphate was deposited as anhydrite from a concentration of sea water in lagoons which were rhythmically replenished. The rhythmic deposition is shown by thin alternating beds of limestone and anhydrite. Relatively soon after deposition the upper horizon of the anhydrite was altered to gypsum. This alteration predates the diastrophism which has deformed the Lower Carboniferous sediments. This origin can be assigned to the bulk of the gypsum rock but not to the surface alteration effects which constitute a small percentage of the deposits. The amount of gypsum now available depends therefore on the amount left by the factors of erosion and not on the depth to which hydration of the anhydrite has progressed.

A series of sealed tube experiments were undertaken and produced the following information. (1) Gypsum is the stable form of calcium sulphate at normal surface temperatures regardless of the sea water concentration. (2) The mechanics of the change from anhydrite to gypsum have been established and also the conditions favourable to this alteration. (3) A range was defined in which the calcium sulphate hemihydrate was stable; this indicated its possible role in the origin of these beds, for this substance would readily change to gypsum or anhydrite depending on the physico-chemical conditions. (4) The possible role was seen of connate waters trapped between anhydrite crystals in the alteration to gypsum soon after deposition.

The margin between the stability range of gypsum and anhydrite was not precisely defined but is considered to be about 40°C.

15. The Isotopic Constitution of Sudbury Galenas. By R. D. Russell, R. M. Farquhar, and G. L. Cumming. Presented by J. T. Wilson, F.R.S.C.

Isotopic analyses of lead from galenas obtained from two mines at Sudbury have previously been reported. These samples had higher Pb^{206} and Pb^{208} abundances than any other galenas yet examined. Additional samples have now been analysed. Two specimens have the isotopic composition of lead separated about 1300 ± 100 million years ago and appear to be in no way "anomalous." The other galenas, including those found in post-ore slips, yield leads with anomalous Pb^{206} and Pb^{208} abundances which are explicable by simple additions of radiogenic lead.

2.00 p.m.—Meeting of the Section.

16. The Determination of the Ages of Lead Ores by Means of Their Isotopic Constitutions. By R. M. Farquhar, R. D. Russell, and J. T. Wilson, F.R.S.C.

Isotopic abundance ratios of lead ores have already been shown to vary with the age of the ores but rather irregularly. A theory is here proposed which provides a method of determining the probable errors for ages determined in this way. It is tentatively suggested that leads whose abundances fall within the prescribed limits of error can be approximately dated. Other leads are held to be anomalous. Their abundance ratios can be explained by additions of radiogenic lead at some time after the ores separated from their parent magmatic sources. New isotopic analyses are given.

17. Preliminary Studies on the Biogeochemistry of Molybdenum. By H. V. Warren, F.R.S.C., R. E. Delavault, and D. G. Routley.

Some wild trees and lesser plants show marked variations in their molybdenum content. These variations can be correlated with the absence or presence of molybdenite in the underlying rocks. Even modest amounts of molybdenite effect a marked response in some vegetation.

Further investigations are needed to confirm our results. However, all our available data point to two conclusions, namely, that biogeochemistry should prove a valuable tool in the search for molybdenum, and that, in biogeochemistry, molybdenum may be a useful pathfinder element in the search for those types of copper and tungsten deposits with which molybdenum is associated in minor amounts.

18. Missi Series, Amisk Lake Area, Northern Saskatchewan. By A. R. Byers. Presented by J. B. Mawdsley, F.R.S.C.

The Missi series occupies two separate synclinal belts within the Amisk group and contacts the Amisk along faults or angular unconformities.

The Missi consists of a basal conglomerate which grades upwards through arkose into greywacke. These sediments are isoclinally folded with development of axial plane foliation. Differential shear parallel to the foliation develops steeply plunging local folds.

Although resting unconformably on Amisk, the nature of the basal conglomerate and structural relationship to the Amisk suggest that deposition occurred during the folding of the Amisk and that the same orogeny affected both assemblages.

19. Problems of Precambrian Stratigraphy West of Sudbury, Ontario. By Jas. E. Thomson, F.R.S.C.

Recent detailed geological mapping in the township of Baldwin, located west of

Sudbury and north of Espanola, has shown that the stratigraphic succession is considerably different from that given by previous investigators. Studies here and elsewhere along the north shore of Lake Huron suggest that the whole sedimentary belt should be remapped in detail as a long-range project. The problems of establishing a satisfactory working basis of correlation during the period of investigation are discussed.

20. Concretion Conglomerate in the Charny Sandstone. By F. Fitz Osborne, F.R.S.C.

The beds of "green sandstone" of the Lower Cambrian Charny formation near Quebec accumulated by downward mass movement of marine sands and gravels in an environment in which shales were being deposited. Carbonate-cemented concretions that had formed in the original sediments became concentrated at the base of a thick bed of sand during the movement and form a conglomerate four feet thick. The concretions, which are as much as a foot in diameter, developed around plaques of shale and give a sample of the texture of part of the original sediments.

21. Fauna and Age of the Kishenehn Formation, Southeastern British Columbia. By Loris S. Russell, F.R.S.C.

In 1950 a palaeontological expedition of the National Museum of Canada to the Kishenehn formation of the Flathead Valley, southeastern British Columbia, resulted in the discovery of a rich fauna of freshwater mollusks. On the basis of these the formation was tentatively assigned to the Middle Eocene. A second expedition in 1952 was able to explore the formation more extensively. Results were the discovery of new localities for the freshwater fauna, the collection of a varied fauna of terrestrial gastropods, and the unearthing of a small mammalian fauna. The fossil mammals have their closest affinities with the latest Eocene and earliest Oligocene faunas. On this basis the Kishenehn formation is tentatively correlated with the uppermost Eocene. Such a correlation necessitates some revision of ideas on the history of the southern Rocky Mountains of Canada.

SECTION V.—BIOLOGICAL SCIENCES

Monday, June 1

11.00 A.M.—Business Meeting of Section (Room 234).

2.00 P.M.—Meeting of Section (Room 234). Papers 1-5.

1. Presidential Address: On Some Fundamental Problems in the Biology of Pacific Salmon. By W. A. Clemens, F.R.S.C.

The paper presents some problems in the systematics, phylogeny, distribution, and migrations of Pacific Salmon, *Oncorhynchus*.

2. Flavelle Medallist's Address: The Story of *Listeria*. By E. G. D. Murray, F.R.S.C.

The discovery of a bacterial disease characterized by monocytosis, focal necrosis, and oedema has led to the emergence of a number of varied biological problems. The disease has been found in nineteen species of animal, including man, in varied forms somewhat species-restricted without difference in the causative bacterium. It has been found in nineteen countries on all continents. The question is raised of relation to cyclical mortality of lemmings. Problems in comparative pathology, physiology, biochemistry of lipids, and the histogenesis of mononuclear leucocytes are indicated. The functions of the monocyte with its relation to active and passive immunity and the source of antibodies are discussed.

3. On the Nutritional Requirements of Young Children. By Thelma Allen, Ada V. MacLeod, and E. Gordon Young, F.R.S.C.

Two nutritional surveys have been made on 156 children of one to six years of age, including physical examination, certain anthropometric measurements and laboratory tests, radiographic assessment of age of ossification, and assessment of food consumption. These observations were repeated at intervals of six months. The nutriture of these children was correlated with the levels of consumption of the essential nutrients of the diet and conclusions are drawn in terms of the minimum requirements which appear to provide normal health and growth.

4. Interpretation of the Postglacial Pine Period in Eastern North America. By Pierre Dansereau, F.R.S.C.

Palynological studies in eastern North America all show one or more prolonged stages of abundant *Pinus* pollen. Such a situation lends itself to many interpretations, some of which are complementary, some of which are contradictory. Two main alternatives are considered. The first postulates that the pines represented in postglacial sediments have the same ecological adjustment as their presumed present-day descendants and that the environment itself forced a longer-drawn rate of succession or presented climatic constellations which are not duplicated at the present time in the Great Lakes area. The second postulates that the postglacial pines had other requirements than those shown by equivalent living species. Six different cases are reviewed together with the various lines of evidence offered by geology, climatology, evolution, genetics, taxonomy, ecology, and phytosociology. Special reference is made to the much neglected assessment of structures of postglacial vegetation types.

5. The Use of Plant Materials in Recognizing Northern Organic Terrain Characteristics. By Norman W. Radforth. Presented by G. Krotkov, F.R.S.C.

Delimited areas in northern organic terrain are demonstrable and classifiable. Differences in physical constitution of the peat material for type areas are expressed. Terrain types are described in which polygon formation is likely to arise. For these, homogeneity in depth and similarity of fibre structure in the peat are characteristic primary features. Physical properties may differ, however, and to reveal this, microfossil studies combined with form analyses of associated living vegetation are utilized. More accurate interpretation of physical conditions of the terrain for ground and air mapping is thus facilitated.

Tuesday, June 2

9.00 A.M.—Meeting of Section (Room 234). Symposium on Recent Approaches to the Control of Diseases and Pests in Plant and Animal Life. Papers 6-9.

6. Chemical Contributions to the Control of Pests and Diseases of Crop Plants. By Hubert Martin.

To the control of the pests and non-nutritional diseases of crop plants, the best-recognized contribution of chemistry has been the provision of chemicals with extreme biological activity. The spectacular growth in manufacture of DDT and 2: 4-D is a reflection of their widespread use, which has not only affected crop husbandry but has realigned the trends of thought on the principles and machinery of research on crop protection.

The chemical industry has directed its resources towards the discovery of biological activity in synthetic compounds and of the range of activity of promising compounds. This latter work has centred mainly on mammalian toxicity for the potential usefulness of the compound is determined largely by the hazards involved in its use.

The academic focus is, on the other hand, the reactions by which the compound interferes with vital processes, not only because of the bearing of these reactions on mammalian toxicity but also because intelligent use in practice is dependent on knowledge of the properties of the compound. The impact of the new chemical, therefore, extends beyond crop protection and stimulates research in allied fields of science.

Plant and insect physiology has shown a remarkable growth. On the one hand, the advantages of the greater availability of biologically standardized test organisms among insects, green plants, and fungi, in comparison with the situation in small animal studies, have attracted academic workers to this field. On the other hand, the known activity of most toxic chemicals as anti-enzymes has prompted many *in vitro* studies in enzymology.

The large-scale use of insecticides had demonstrated that the classroom of the ecologist is in the wheat field and fruit plantation as well as in the undisturbed forest or heath. Ecology should now rapidly expand as an applied science for it has become painfully apparent that, before a pest control chemical can be extensively recommended, a foreknowledge is necessary of its effect on the complex biological environment in which it is to be used. Although climatic and nutritional factors are very important in this interplay, chemicals, whether produced *in situ* or in the factory, also have their part; a new science, ecological chemistry, is emerging.

7. Developments in Control of Forest Insects. By J. MacBain Cameron.

Control of forest insects can be divided into two categories—chemical control and biological control. Chemical control in most cases should be considered only a means of protecting a crop for harvest, and not a method for eradicting a pest. Biological control may be effected in some cases by silvicultural methods, and parasites and predators have been under study and some degree of manipulation for many years, with variable results. Diseases have been intensively studied only comparatively recently, and good practical results have been obtained in several cases. Further knowledge of fundamentals as well as of applications is necessary, and is being obtained as rapidly as possible.

8. Genetic Resistance to Disease in Domestic Animals and Man. By F. B. Hutt.

Genetic resistance of animals to disease, to parasites, and to nutritional deficiencies has been repeatedly demonstrated. Examples will be discussed to show the importance of such genetic differences and their relation to the control of specific serious diseases in domestic poultry, swine, sheep, and cattle. Similar examples of genetic resistance to infectious and idiopathic diseases in man will be briefly considered, along with the relation of genetics to the prevention of human disease.

9. The Implications of Recent Advances in Medical Bacteriology. By E. G. D. Murray, F.R.S.C.

Recent advances in medical bacteriology are reviewed selectively, not exhaustively, with the purpose of indicating findings of general biological significance and suggesting lines of fruitful investigation. The limitations and selectiveness of sulphonamides and antibiotics are considered not so much in the light of what they do as curative agents as what they fail to do.

The need to know what cellular functions they interfere with is emphasized. The effects of environmental changes, introduced by the general use of antibiotics, on parasitic and pathogenic bacteria, are viewed as an influence on evolutionary changes in susceptible species. The possibilities inherent in genetic transformations of bacteria are related to the significance of these observations for bacterial taxonomy, for the development of changes in pathogenicity and for the character of infectious diseases. The need for co-ordination of medical and veterinary medicine and for an extended study of infectious diseases of wild life is illustrated. The importance of recent methods of propagation of viruses in tissue culture is touched on.

Tuesday, June 2

2.00 P.M.—Meetings of Sub-section BOTANY and ZOOLOGY (Room 219). Papers 10-15.

10. Kinetic Studies of the Catalase System of Wheat. By G. N. Irvine, W. Bushuk, and J. A. Anderson, F.R.S.C.

Crude catalase extracts from wheat exhibit first order kinetics with rate constant proportional to the enzyme concentration. Unlike the crystalline enzyme, the crude

enzyme is not inactivated by the hydrogen peroxide substrate. The activation energy over the range 10-30°C. is 2,800 calories. A postulated mechanism for the reaction is based on the scheme of Britton Chance; it is suggested that there is no true Michaelis constant for the system, but a pseudo K_m value can be obtained and its significance is discussed. Studies of cyanide inhibition do not serve to classify the type of inhibition but permit an approximate calculation of the enzyme concentration.

11. Some Effects of 3-(*p*-Chlorophenyl)-1: 1-Dimethyl Urea on the Morphology and Physiology of Plant Roots. By W. Harold Minshall and Duncan A. McLarty. Presented by W. F. Hanna, F.R.S.C.

After five days in a series of graded concentrations of 3-(*p*-chlorophenyl)-1: 1-dimethyl urea the growth of timothy roots was suppressed 50 per cent by a 64 p.p.m. solution and was suppressed completely by a 256 p.p.m. solution. Growth of root hairs was completely suppressed at concentrations which permitted some growth of seminal roots. Cytological studies suggest that the suppression of root growth is effected by the suppression of mitosis.

12. Synthesis of Sucrose and Starch in Tobacco Leaves from Infiltrated C^{14}-labelled Glucose and Glucose-1-Phosphate. By P. V. Vittorio, G. Krotkov, F.R.S.C., and G. B. Reed, F.R.S.C.

Detached tobacco leaves were infiltrated with C^{14}-labelled glucose and glucose-1-phosphate, and placed for six hours under various external conditions. At the end of this time sugars and starch were extracted, and their specific and total activities determined. The specific activities of both glucose and fructose moieties of sucrose were high and equal, while the activity of the free fructose was lower. From this it has been concluded that the fructose moiety of sucrose arises from infiltrated glucose and not from the free fructose. The mechanism of sucrose synthesis in tobacco leaves is, therefore, different than that reported for *Pseudomonas saccharophila*.

Contrary to expectation, radioactive sugars infiltrated into tobacco leaves contributed only a small amount of their activity to starch. On the other hand when leaves were permitted to carry on photosynthesis in the presence of $C^{14}O_2$, the starch produced was highly radioactive. These results are explained by the supposition that, while sucrose phosphorylase is located in cytoplasm, starch phosphorylase is present only in plastids.

13. Metabolism, Body Size, and Growth. By Ludwig von Bertalanffy. Presented by J. R. Dymond, F.R.S.C.

Comparative studies on the main animal phyla show that the surface rule of metabolism applies approximately to mammals, and strictly to poikilothermic vertebrates and certain invertebrates, while in other groups different relations between metabolism and body size are found. The familiar explanations (homeothermy, etc.) of the surface rule and related formulations are, therefore, inadequate. The relations between tissue respiration, body size, and total metabolism were studied. Exact relations, apparently applying to the entire animal kingdom, can be stated between "metabolic types" (i.e., the relation of metabolism to body size) and "growth types" (i.e., the characteristic course of growth).

14. Comparative Studies of the Effects of Insecticidal Poisons on Certain Physiological Phenomena in Insects. By A. W. A. Brown. Presented by G. Edward Hall, F.R.S.C.

The physiological effects of 26 compounds used as insecticides, including chlorinated hydrocarbons, organic phosphates, botanicals, dinitro compounds, and organic thiocyanates, were tested on the roaches *Periplaneta americana* and *Blattella germanica*. Most compounds exerted a stimulatory effect on the respiration of the poisoned insects, some immediately and others after a latent period; a few compounds exerted a depressant effect. Some compounds stimulated the rate of heart-beat, others depressed it, while most had little effect. Nearly all the compounds increased the action potentials of isolated nerve, many causing the repetitive discharge observed with DDT; in some cases there was a long latent period, corresponding with that obtained for the respiratory effect. Most of the compounds had an inhibiting effect on the cytochrome oxidase of muscle, many requiring a latent period before the inhibition developed.

15. The Effect of Temperature and Humidity on the Toxicity of Rotenone to the Mexican Bean Beetle. By Robert J. Harrison. Presented by Georges Maheux, F.R.S.C.

The importance of temperature and relative humidity in rotenone toxicity against fourth instar larvae has been established under controlled laboratory conditions. Temperature exerts more influence on larval resistance to rotenone toxicity than relative humidity. At a constant *relative humidity* the loss of weight of this insect is directly proportional to temperature, while at a constant *temperature* it is inversely proportional to the relative humidity. The *zero loss of weight* is defined as "the temperature at which, theoretically, larvae will stop showing a loss of weight." The linear relationship existing between temperature and the loss of body weight is presented by a simple mathematical formula.

Tuesday, June 2

2.00 P.M.—Meeting of Sub-section PHYSIOLOGY and MEDICAL SCIENCES (Room 234). Papers 16-22.

16. Photometric Titration of Serum Calcium. By Walter R. Campbell, F.R.S.C.

Schwarzenbach has used the unstable dye-stuff ammonium purpurate with his chelating agent disodium-dihydrogen-ethylenediamine-tetra-acetate-dihydrate to determine the calcium hardness of water and Elliot has applied it to determine serum calcium.

By simple means the instability of the dye-stuff has been overcome but visual determination of the colour change is difficult. Spectrograms of the calcium purpurate and the uncombined purpurate show a considerable difference in density at certain wave-lengths. Accordingly a simple device for determining the end-point has been developed which permits accurate determination of serum calcium by titration in a few minutes.

17. Bioassay of Insulin by a Modified Compensation Method. By A. Bruce Macallum, F.R.S.C.

The glucose compensation method developed by Bouckaerdt and Duve (Physiol. Rev., 27, 1947: 39) for ascertaining the distribution of glucose in the body by insulin has been modified for the bioassay of insulin. Seven crystalline zinc insulin preparations (3 British, 3 American, 1 Canadian) were used where unit values ranged between 22-28μ/mgm. The glucose compensation values are closely correlated to the unit values supplied by the manufacturers.

All of the mean values of the different makes lie within the confidence limits of any one mean value. Individual animals maintain their own values for over seven hundred days.

18. Dosage du testostérone par l'acide molybdique en milieu sulfurique. Par Jules Labarre, M.S.R.C., et Etienne-Adonaï Martin.

Le testostérone fournit avec l'acide molybdique en milieu sulfurique, une coloration caractéristique (600 millimicrons). Pour des concentrations en testostérone variant de 2 à 30 gammas, on obtient une coloration stable, après dilution optimale du mélange sulfurique.

La désoxycorticostérone et la cortisone donnent aussi une réaction positive, mais à des concentrations supérieures (100 gammas).

19. Dosage du testostérone par la ninhydrine (tricétohydrindène hydraté). Par Jules Labarre, M.R.S.C., et Etienne-Adonaï Martin.

Le testostérone, en présence de la ninhydrine en milieu sulfurique, développe une coloration violette (580 millimicrons). Cette réaction est suffisamment sensible pour permettre le dosage de 0.5 à 20 gammas de testostérone, dans 5 ml de mélange final.

Les essais effectués indiquent que la température, la concentration acide, la proportion de réactif, etc., influencent l'intensité de la coloration.

20. A Comparison of the Inactivation of Chorionic and Serum Gonadotrophins by Periodate and by *Lithospermum* Extracts. By E. T. English and R. L. Noble, F.R.S.C.

The *in vitro* ability of various *Lithospermum croceum* extracts to inactivate, partially or completely, pregnant mare's serum and human chorionic gonadotrophins has been demonstrated previously in this laboratory. Whitten (Australian J. Sci. Research, B3, 1950: 346) has shown that periodic acid is capable of inactivating pregnant mare's serum gonadotrophin *in vivo*.

The present work has extended the *in vitro* inactivation to human chorionic gonadotrophin. A comparison has been made of the inactivating potency of *Lithospermum croceum* water extracts with that of periodate, with respect to pregnant mare's serum gonadotrophin. On the basis of histological examination of ovaries from treated animals a qualitative difference has been found between the two series, indicating that the mode of inactivation by these two substances is different.

21. The Presence of an Interfering Substance in Extracts of *Lithospermum*. By R. C. B. Graham and R. L. Noble, F.R.S.C.

It has been noted that water extracts of various species of *Lithospermum* (*L. latifolium*, *L. croceum*, *L. ruderale*, and *L. officinale*) contain an inhibitor that interferes

with the inactivation of pregnant mare's serum gonadotrophin, when mixed in high concentration. Dilution of these extracts permits the *Lithospermum* to inactivate P.M.S.

The inhibitor is not destroyed by boiling with HCl. It is soluble in 1 per cent to 20 per cent $CaCl_2$, but insoluble in 30 per cent to saturated $CaCl_2$.

The inhibitor is not present in dialysed extracts, and is not soluble in alcohol or ether-alcohol solutions.

Glucose, lactose, and xylose do not interfere with the inactivation of P.M.S. by *Lithospermum*.

22. Inhibition of Erythrocyte Glyoxalase by Derivatives of Phenothiazine. By H. B. Collier. Presented by N. H. Grace, F.R.S.C. (By title.)

Phenothiazone has been found to be a strong inhibitor of glyoxalase activity of human and rabbit erythrocytes. Concentrations for 50 per cent inhibition were 10^{-6} *M* for intact cells and 10^{-4} *M* for haemolysates with added glutathione. Glyoxalase activity was also markedly inhibited by phenothiazine, methylene blue, and *p*-chloromercuribenzoate; slightly inhibited by alloxan and phenylhydrazine; and not affected by dialuric acid. Enzyme inhibition did not parallel methaemoglobin formation. The possible relationship of these findings to the haemolytic action of phenothiazine is discussed.

Tuesday, June 2

3.30 P.M.—Visit of Section to Science Service Laboratory.

Wednesday, June 3

9.00 A.M.—Meeting of Sub-section BOTANY and ZOOLOGY (Room 219). Papers 23-34.

23. The Inheritance of Pathogenicity in Selfing and Crossing of Physiologic Races of *Puccinia graminis* var. *tritici*. By T. Johnson, F.R.S.C.

Most wheat stem rust races are heterozygous for infection types on one or another of the differential hosts. In crosses, the production of necrotic flecks or minute uredia on Reliance, Kota, Einkorn, and Vernal is dominant to the production of large uredia. On durum varieties the reverse is true. On Marquis, the infection type resembles that of the "maternal" parent race, the genes for pathogenicity evidently being influenced by the rust cytoplasm in which they act. Abnormal pathogenic characteristics are not uncommon. In the selfing of one race, some infections on wheat produced abortive pycnia instead of uredia.

24. *Ascocybe*, a New Genus of Lower Ascomycetes. By Doreen E. Wells. Presented by J. Walton Groves, F.R.S.C.

A fungus belonging among the primitive Ascomycetes has been found as a common saprophyte on wood, causing a superficial brown discolouration on sawn timber. Proliferating asci are produced in branched chains from the apex of an upright brown

stalk. The asci contain four hat-shaped spores similar to those found in several other genera, e.g. *Ascoidea*, and *Endomyces*.

The fungus is homothallic and grows rapidly on malt agar producing the perfect state almost simultaneously with the imperfect state. It is necessary to erect a new genus for this fungus, because of the specialized structure on which the asci are produced.

25. The Genus *Durandiella*. By J. Walton Groves, F.R.S.C.

The genus *Durandiella*, founded on *Peziza fraxini* Schw., includes a group of inoperculate Discomycetes occurring on twigs and branches of woody plants. The apothecia are flat, black, very hard in consistency, and have eight-spored asci with filiform ascospores. All of the species have subfiliform conidia of similar form but the form of the conidial fruiting body varies in different species. Only two species have been placed in this genus previously, but seven additional species, of which two are undescribed, also belong here and form a natural group.

26. The Fern Genus *Dryopteris* in British Columbia. By T. M. C. Taylor. Presented by A. H. Hutchinson, F.R.S.C.

The occurrence of eight species of *Dryopteris* complex has been established, several of which have very limited ranges.

27. Un nouvel *Eriophorum* hybride de la Béringie. Par Marcel Raymond. Présenté par Jacques Rousseau, M.S.R.C.

Description d'un remarquable *Eriophorum* hybride entre *E. angustifolium* et *E. Chamissonis*. Le résultat est une plante de grande taille polystachyée comme dans la première espèce et à soies roux pâle comme chez la seconde. L'hybride est fréquent en Alaska et à l'île Saint-Laurent, au large de la Sibérie.

28. Le *Carex supina* en Amérique du Nord. Par Marcel Raymond. Présenté par Jacques Rousseau, M.S.R.C.

Longtemps tenu pour rare en Amérique du Nord, le *Carex supina* est maintenant connu depuis le Groenland, Baffin, Ungava, Labrador, jusqu'en Alaska, avec deux localités au Minnesota. La plante américaine diffère de l'européenne et déborde sur l'Asie orientale.

29. Euchromatic Structures in Root-tips of *Allium cepa* using Brilliant Cresyl Blue Stain. By H. Sweet. Presented by A. H. Hutchinson, F.R.S.C.

In cytological studies of *Allium cepa* use was made of the stain brilliant cresyl blue. Euchromatic bodies are stained readily in contradistinction to heterochromatic structures. Microphotographs illustrate features of the chromonemata especially the spiralization and evidence of discontinuity, also the arching of the anaphase chromatids and coiling in telophase stages.

30. A Comparison of Some Seasonal and Temperature-induced Changes in Deer Mice. By J. S. Hart. Presented by W. H. Cook, F.R.S.C.

The cold resistance of mice captured in winter was greater than that of summer mice and was accompanied by a lower oxygen consumption at 1-2°C. and a greater pelage insulation. On the other hand, the greater cold resistance of mice acclimated to lower temperatures was not accompanied by differences in oxygen consumption at 1-2°C. or in pelage insulation. These results suggest that factors in addition to temperature are responsible for some of the observed seasonal changes.

31. The Effect of Inbreeding and Selection on Body Size in the Mouse. By L. Butler. Presented by J. R. Dymond, F.R.S.C.

Two strains of mice with large differences in body size were inbred. Concomitant with inbreeding, selection was applied to increase the body size of the large strain and decrease the size of the small strain. No inbreeding depression was observed in vigour, and only a minor decrease in litter size. In the large strains, the size stayed constant; in the small strain, size increased with each generation. It appears that in the large strain the selection applied was equal to the opposing natural selection, whereas in the small strain the selection applied was not enough to counter natural selection.

32. Temperature Selection in a Small Mammal. By R. H. Stinson and Kenneth C. Fisher, F.R.S.C.

When placed in either a horizontal or a vertical gradient of temperature, the prairie deer mouse, *Peromyscus maniculatus bairdii*, was observed more frequently within a certain area designated as the region of selected temperature. The temperatures involved in this reaction appeared to be those of the surface upon which the animal moved; they generally fell between 20° and 30°C., with a modal value at 25°C. There was some evidence of a shift upward in the temperature selected after animals had been kept at 33°C., and a shift downward after a period at 15°C.

33. Cover Response in the Sucker. By C. W. Andrews. Presented by A. G. Huntsman, F.R.S.C.

In tanks, each with two connected compartments, either of which could be exposed to light from the sky, suckers on exposure moved from the lighted to the dark compartment or vice versa, thus taking or leaving cover. As in nature, the smallest fish (underyearlings) left cover at all light intensities from full sunlight to starlight, but were inactive late at night and until sunrise or even later. Larger fish took cover in sunlight and early twilight, but only in shallow water; otherwise they left cover.

34. Some Effects of Urethane (Ethyl Carbamate) on Mitosis and Morphogenesis. By Helen I. Battle. Presented by G. Edward Hall, F.R.S.C.

Eggs of the brown trout, zebra fish, and frog were exposed to concentrations of urethane up to 0.75 per cent. An initial increase in metaphases, anaphases, and telophases in proportion to concentration in the multicellular blastoderm of teleostean eggs, is followed by a reduction in number of mitotic figures and an apparent prolongation of the interphase. Increasing numbers of atypical nuclear configurations appear with increasing concentration and exposures and include predominantly binucleate to multinucleate giant cells, multipolar spindles, and pycnosis. Mitochondria exhibit differential susceptibility to stains, lose in varying degrees their

typical pattern of distribution in the cytoplasm, become swollen, and ultimately coalesce into clumps, which effects may represent physical evidence of the interference of urethane with the respiratory enzyme systems.

Subjection of the eggs of the zebra fish and frog to urethane throughout development results in retardation of both growth and differentiation of embryonic structures, the effects being cumulative and proportional to concentration and to the initial stage of development on exposure. Anomalies include malformation of axial structures, extensive coelomic oedema, hydropic degeneration of body tissues, vascular stasis, and epithelial hyperplasia. The effects produced are probably attributable to the intact urethane molecule, since retardation of development induced by related molecules (urea, etc.) appears to be general and not differential in any particular areas or organs.

Wednesday, June 3

9.00 A.M.—Meeting of Sub-section PHYSIOLOGY and MEDICAL SCIENCES (Room 219). Papers 35-44.

35. Measuring the Volumes of Small Mammals. By I. Maclaren Thompson, F.R.S.C., P. A. Macdonald, and M. E. Stover.

In connection with a study of the rapid growth of the golden hamster (*Cricetus auratus*), it is desired to measure growth in volume as well as in weight and in certain linear dimensions. A pressure system has been devised for this purpose, based on the displacement of air. The apparatus and its use will be described.

36. Ice Propagation in Systems of Biological Interest. By W. H. Cook, F.R.S.C., and C. V. Lusena.

If membranes in biological tissues prevent ice crystal penetration, freezing must take place in a discontinuous manner at rapid rates of cooling. Studies in a model system show that membranes may prevent, retard, or permit ice crystal penetration. Discontinuous behaviour is favoured by low membrane porosity, rapid cooling, and increasing concentrations of solutes in the aqueous phase. Specific properties of the membranes and solutes are also important. In sucrose and gelatin solutions, supercooling and nucleation ahead of the ice front can be demonstrated. The results will be considered in relation to the ability of living cells to survive freezing.

37. Propagation of Viruses and Development of Neutralizing Antibody in the Bovine Mammary Gland. By Charles A. Mitchell, F.R.S.C.

The problem of protecting various hosts is intimately associated with the production under suitable conditions of considerable quantities of the appropriate virus or of antibodies capable of neutralizing specific viruses. Several methods, such as chick embryo and tissue culture propagation, are being extensively explored at the present. The author presents data indicating that at least two viruses are capable of propagating within the mammary gland and later that this propagation is followed by the local production of neutralizing antibodies which may be found in both the blood and milk serum.

38. Dispersion of Labelled BCG in Normal Guinea-Pig. By J. Sternberg, M. O. Podoski, and A. Frappier, F.R.S.C.

Labelled BCG (with P 32) was injected subcutaneously in normal guinea-pigs, in quantities ranging from 1.2 mg. to 4.0 mg. dry weight per animal. The animals were killed at different intervals of time after injection (48 hours, 5, 7, 11, and 15 days) and the radioactivity of spleen, lungs, liver, and of the point of injection was measured. The living bacilli were counted in the same organs.

BCG is found in organs only 7 days after injection. In lungs, the microbes are concentrated around the hilar region. In the inoculation region, the radioactivity is approximately 100 to 150 times greater than in other organs; probably it is related to the proportion between the bacilli trapped at the site of injection and those dispersed in the organs.

39. Status of the Tricarboxylic Acid Cycle in *Pseudomonas aeruginosa*. By R. A. Smith, J. J. R. Campbell, and B. A. Eagles, F.R.S.C.

Sonic extracts of *Pseudomonas aeruginosa* have been found to accumulate citric acid when either pyruvate or succinate was employed as substrate. With citrate as substrate both α-ketoglutarate and pyruvate were isolated. These data confirm the presence of the tricarboxylic acid cycle in this organism. However, sonic extracts of *P. aeruginosa* were also found to dissimulate citric acid under anaerobic conditions, thus showing that some scheme other than the conventional cycle is also operative.

40. Pathway of Glucose Oxidation by *Acetobacter melanogenum*. By H. Katznelson. Presented by A. G. Lochhead, F.R.S.C.

Resting cells of *Acetobacter melanogenum* oxidize glucose, gluconate, and 2-ketogluconate with production of a common end-product. Old intact cells and cell-free preparations utilize 1.5, 1.0, and 0.5 μM O_2 respectively per μM of the above substrates with no CO_2 evolution. Fresh intact cells carry out further oxidations with CO_2 evolution; in presence of 2,4-dinitrophenol their metabolism resembles that of aged cells. Chemical evidence suggests that the end-product is 2,5-diketogluconic acid, an unstable compound which decomposes to produce the brown colour characteristic of *A. melanogenum* when grown on glucose or gluconate media.

41. Phases of the Euchromatic Life Cycle of *Bacillus subtilis*. By A. H. Hutchinson, F.R.S.C., V. H. Tunbridge, and M. Elvin.

Photomicrographic evidence is submitted for mitosis, syngamy, and meiosis in *Bacillus subtilis*. Dormant cultures were obtained from Dr. C. E. Dolman. At a temperature of 40°C. the cytological cycle is completed in a period of two hours. A specific combination of chromic, acetic, osmic acids, and formalin is used as fixative. The stain is Giemsa's. Considerable structural detail of euchromatic progression is observed and compared with the cytology of other forms.

42. The Carcinogenic Action of 9-10 Dimethyl 1-2 Benzanthracene in Hypophysectomized Rats. By J. H. Walters and R. L. Noble, F.R.S.C.

The report of the inhibitory role of hypophysectomy in methylcholanthrene carcinogenesis (Henry D. Moon, M. E. Simpson, and H. M. Evans, Science, 116, 1952: 331) was of such fundamental importance that an attempt has been made to verify this work, using a more potent carcinogenic agent.

Ten control and 21 hypophysectomized rats of the Sprague-Dawley strain were

injected in the right thigh with 5 mgm. of 9-10 dimethyl 1-2 benzanthracene. In 7 weeks a palpable mass was noted in the injected legs and at the end of 18 weeks 6 out of 8 control and 6 out of 8 of the remaining hypophysectomized rats had developed tumours.

43. Cystine-cysteine Concentration in Homogenate and Cell Fractions of Regenerating Preneoplastic and Tumour Rat Liver. By Antonio Cantero, Gaston de Lamirande, and Claude Allard. Presented by L. C. Simard, F.R.S.C.

Polarographic study of the cystine–cysteine concentrations of rat liver homogenate and cell fraction has revealed no significant changes during carcinogenesis except after sixty days of DAB feeding when a significant decrease in the homogenate nuclear and mitochondrial fractions is observed as compared to control.

The tumour cystine–cysteine concentration increases in homogenate and supernatant fraction when calculated on a per gm. basis. However, on a per cell and per mitochondrion basis, increases are noted in all fractions. These changes when related to the nitrogen content show an increase which is different from that of normal regeneration, and more extensive. This difference may be a factor in the irreversibility of the abnormal growth process.

The average mitochondrion of tumour liver cell, regenerating liver cell, and liver cell of rats fed DAB for ninety days shows an increased concentration of cystine–cysteine.

44. The Development of Hyperlipemia in Sprague-Dawley Rats Bearing the Walker 256 Carcinoma. By G. L. Frederick and R. W. Begg. Presented by J. B. Collip, F.R.S.C.

Serial determinations of serum total fatty acids, serum phosphatase, and urinary nitrogen excretions were made on individual male rats during the growth of Walker 256 Carcinoma. Extreme hyperlipemias were found shortly after the mid-point of tumour growth, followed by some regression. The hyperlipemia was due chiefly to increased esterified fatty acids. Serum phosphatase decreased markedly at early stages of tumour growth. Urinary nitrogen excretion increased terminally. Serum total fatty acids were determined in individual rats at different stages of fasting. Levels rose from 4 to 8 hours, then decreased in most rats. Some rose constantly up to 16 hours.

Wednesday, June 3

11.50 A.M.—Business Meeting of Section (Room 234).

Wednesday, June 3

2.00 P.M.—Meeting of Sub-section BOTANY and ZOOLOGY (Room 219). PAPERS 45-49.

45. Le genre *Cirriphyllum* dans le Québec. Par James Kucyniak. Présenté par Jacques Rousseau, M.S.R.C.

Brotherus signale 16 espèces pour le genre et Grout 4 pour le n.e. de l'Amérique du Nord. A date, *C. piliferum* seul est connu pour le Québec. Carte de distribution;

indications d'habitats et d'associations susceptibles d'orienter les recherches futures. *C. cirrhosum* et *C. Boscii* déjà connus des régions limitrophes sont à rechercher ici.

46. Une nouvelle espèce de *Lathyrus* et quelques éléments nouveaux du Québec arctique et subarctique. Par Jacques Rousseau, M.S.R.C. et Marcel Raymond.

L'un des auteurs a rapporté du Québec arctique quelques entitées nouvelles pour la science. Parmi celles-ci, il y a lieu de distinguer une nouvelle espèce de *Lathyrus* maritime du même groupe que la *Lathyrus japonicus*. Hulten avait déjà remarqué semblable plante dans les îles Aléoutiennes. Les auteurs en font la description et dédient cette espèce à Hulten.

47. The Significance to Organisms of Thermal Conditions in Running Waters. By F. P. Ide. Presented by J. R. Dymond, F.R.S.C.

The stream habitat has been less investigated from the standpoint of temperature conditions than has that of static water.

Examples are given of diurnal changes in temperature with analysis of the causes and discussion of maximum, mean, and minimum temperatures. The seasonal trend is then examined with a discussion of melting of the ice, warming up of the water in the early season and cooling down in the fall. From continuous records the duration of temperatures in arbitrary 5°F. ranges are summed and the curves obtained are found to parallel closely the development of different organisms.

48. Culture Methods Simulating Natural Conditions for Marine Algae of Economic Importance, II. By R. F. Scagel. Presented by A. H. Hutchinson, F.R.S.C.

This study has extended over several years and has been limited to the agar-producing genus *Gracilaria* and the algin-producing genera *Macrocystis* and *Nereocystis*. The primary aim is to gain information regarding the life histories which would permit field application of the principles established. Field studies and laboratory experiments follow a complementary plan. During the past year primary consideration in laboratory experiments was given to *Macrocystis*.

49. Life's Progressive Orderliness Based on the Binary Statistic of Genic Alleles. By A. H. Hutchinson, F.R.S.C.

Genes are quantisized genotypically and phenotypically. They occur in pairs (alleles). The basic number is *two*. After fifty years Saunders' Marquis wheat is Marquis wheat.

The orderly binary statistic is expressed: genotypes, heterozygous for 1, 2, 3, 4 or n alleles produce 2^1, 2^2, 2^3, 2^4, . . . 2^n classes of gametes which recombine to produce 2^1, 2^2, 2^3, 2^4 . . . 2^n genotypes; these occur in the proportions 2^1, 2^2, 2^3, 2^4 . . . 2^n according to the degree of heterozygosity of each, having respect to the limitations of least numbers 2^2, 4^2, 8^2, 16^2 . . . $(2^n)^2$ respectively, where n is the number of alleles.

Specific binomials express the relative frequency of phenotypes resulting from the quantisized interaction of supplementary genes.

Progression is the product of mutations which are quantisized in direction, rate, magnitude, and allelic position on homologous chromosomes.

Biotic orderliness arises from genic orderliness.

Wednesday, June 3

2.00 P.M.—Meeting of Sub-section PHYSIOLOGY and MEDICAL SCIENCES (Room 234). Papers 50-54.

50. The Response of Intestinal Alkaline Phosphatase of Fasted Rats to Force-fed Fat. By Jules Tuba and Margaret I. Robinson. Presented by N. H. Grace, F.R.S.C.

Rat intestinal alkaline phosphatase consists of an adaptive portion which varies with the dietary state, and a non-adaptive fraction which remains constant even during prolonged fasting. The adaptive enzyme is probably translocated, during fat absorption, by the lymphatic route and thus serves to elevate serum levels of alkaline phosphatase. Protein reserves in the liver and intestine can be lowered by prolonged fasting to the extent that the ingestion of fat, the normal stimulus for further synthesis of the intestinal enzyme, cannot produce complete replacement of the non-adaptive enzyme which has been lost to the serum.

51. The Granules of the Granular Pneumonocytes of White Mice. By Charles C. Macklin, F.R.S.C.

After heavy osmiumization varisized darkened granules appear. Under the polarizing microscope many granules look like pale moons with thin luminous edges suggesting fluid droplets within lipid capsules. That they may be ruptured experimentally by *in vivo* intrabronchial decompression (Macklin, Anat. Rec., Feb., 1953) and their contents disseminated first into the cytoplasm and then into the contiguous pulmonary capillaries is suggested by the remarkable formalin pigment in and beyond the lung. Certain evidence hints that the material so scattered acts as a catalyst in the precipitation of formalin pigment.

52. The Method of Release of Discrete Cytoplasmic Portions by Basophilic Cells (Changed Lymphocytes) from the Thymus *in vitro*. By V. E. Englebert. Presented by K. C. Fisher, F.R.S.C.

During culture experiments with thymic lobules of chick embryos and young rats, it was observed directly that cytoplasmic fragments were released from lymphocytes. The release began by the formation of a tubular process through which discrete portions of the cytoplasm emerged from the endoplasm of the cell. They passed slowly out the tube to the end, and eventually end pieces, each containing its discrete portion of cytoplasm, twisted off and floated away into the medium. This was not clasmatosis as that process is usually understood, nor a degeneration nor yet a disintegration, but the carrying out of a function of living cells.

53. The Excretion of Orally Administered Water in Hypophysectomized Rats. By D. C. Jessup and R. L. Noble, F.R.S.C.

The present study concerns the inability of hypophysectomized rats to show a normal water diuresis after the oral administration of water. This effect becomes evident 24 hours post-operatively. However, untreated rats of the Sprague-Dawley strain manifest a spontaneous return of the ability to excrete a water load within 10 to 18 days after hypophysectomy. This observation is contrary to that of others who found the inhibition of diuresis to be permanent and to persist up to 14 weeks post-operatively.

The results will be discussed in relation to possible hormone alterations, and the response of different strains of rats.

54. Some Unusual Reactions in the Rabbits to Crude Preparations of the Specific Metabolic Factor of the Pituitary Gland.

By J. B. Derrick, D. Schwartz, and R. L. Noble, F.R.S.C.

During the course of investigations on the specific metabolic factor of the pituitary (Derrick and Collip, Can. J. Med. Research, 1953) it became apparent that the various preparations were, on occasion, toxic to rabbits when injected subcutaneously. In view of the infrequency with which pituitary preparations have been accredited with toxicity the effects have been further investigated.

Some preparations have been found to have lethal properties and the animals die within 2 to 24 hours after subcutaneous infection. A profound, prolonged lowering of the blood pressure is also a property of these extracts although it is believed that it is not necessarily connected with the lethal effects. Paralysis may occur. Histological changes have been observed. There have been some instances of toxicity in the white rat.

The investigations are being extended to more refined extracts.

OCEANOGRAPHIC SESSION

(Arranged by Canadian Committee on Oceanography)

Wednesday, June 3

8.00 P.M.

1. Characteristics of the Waters of British Columbia Inlets. By G. L. Pickard. Presented by W. A. Clemens, F.R.S.C.

Most inlets have a copious freshwater supply from rivers resulting in a brackish surface layer of 10-30 ft. depth under which the water is nearly as saline as that outside the inlets. The water below 60-100 ft. is longitudinally homogeneous and generally increases in salinity and decreases in temperature from south to north along the coast. A temperature minimum at 100-300 ft. is characteristic of the water in the inner half of most inlets. It is attributed to winter cooling and its persistence during the summer suggests that the main inflow of saline water may occur chiefly *above* its depth.

2. Wind Currents and Dominant Surface Flow at Sambro Lightship. By H. B. Hachey, F.R.S.C., and N. O. Fothergill.

Observations over a period of seven months indicate that winds greater than 10 m.p.h. determine the direction and strength of the prevailing surface currents at Sambro Lightship. In the absence of such winds the dominant surface flow may be from the northeast, east, or southwest. Internal adjustments in the water mass, as a result of winds and pressure gradients, are described.

3. The Easterly Flow of Slope Water South of the Grand Banks. By H. J. McLellan. Presented by H. B. Hachey, F.R.S.C.

The slope water off the Scotian Shelf is the area of origin of an easterly flowing current which has been repeatedly observed south of the Grand Banks. While it is not formed by a simple branching of the Gulf Stream, it obtains momentum and as much as 75 per cent of its volume from the Gulf Stream.

4. Transport and Concentration of Planktonic Stages of an Estuarine Barnacle. By E. L. Bousfield. Presented by A. G. Huntsman, F.R.S.C.

Balanus improvisus lives on the bottom of the middle and outer part of the shallow Miramichi estuary of eastern New Brunswick. Larvae from the adults are transported in the residual movements of the water under hydrodynamic (salinity and temperature differences), tidal and wind forces. Their depth in the water, increasing with development, determines (with differential movement of the water with depth) their concentration, first in the main outflow along the south side of the estuary, then in the middle near the mouth, and finally in the main inflow along the north side. This accords with the effect of the earth's rotation on water movement.